The Veterinary Record, October 29th, 1960 Price 2s.

Vet.
RECEIVED
NOV 23
VET. MED. LIBRARY
OHIO STATE UNIVERSITY
NOV 22 1960

THE JOURNAL OF THE BRITISH VETERINARY ASSOCIATION

The Veterinary Record

PATRON: HER MAJESTY THE QUEEN

Vol. 72 No. 44 Issue No. 4301 917-956 Registered as a Newspaper

A NEW EAR WAX REMOVER—

and remedy for parasitic mange in dogs and cats

TRIBUTES FROM A FIELD TRIAL

- "especially useful because of its property of dissolving wax".
- "often no cleaning with forceps and wool was necessary".
- "This product has been found to be exceedingly good also in certain ear conditions not readily curable".
- "Two main types responded best, namely, parasitic mange and accumulation and hardening of wax secretion causing irritation".

**Vet. Rec. 1959, 71, 143*

CERUVET

(Trade Mark)

VETERINARY EAR DROPS

Particularly effective in parasitic mange and accumulation of hardened wax, especially in long-haired dogs.

- NO OTHER MEDICATION OR TREATMENT NECESSARY
- SAFE—NON-IRRITATING—ANTI-BACTERIAL
- EASILY APPLIED—HARMLESS TO THE LINING OF THE EAR

Supplied in 14 ml. vials with dropper

Literature gladly sent on request

LABORATORIES FOR APPLIED BIOLOGY LTD.

91, AMHURST PARK, LONDON, N.16 TELEPHONE: STAmford Hill 2252/3

ECTOPARASITE AEROSOL for the destruction of lice, fleas and other ectoparasites on small and large animals. Does not stain fleece or fur.

142 gm. units in cases of 6 and 12.

AEROSOL 1053—an efficient combination of insecticidal and deodorising materials.

142 gm. units in cases of 6 and 12.

ODOUR SUPPRESSANT AEROSOL—to mask the odour of bitches in season.

142 gm. units in cases of 6 and 12.

CHLORAMPHENICOL AEROSOL—for the treatment of foot-rot in sheep.

114 gm. units in cases of 6 and 12.

SOMERSET PHARMACEUTICALS LTD

WELLINGTON, SOMERSET-*Phone:* Wellington, Som. 2244

THE VETERINARY RECORD

Founded by William Hunting, F.R.C.V.S., in 1888

Volume 72
No. 44

SATURDAY, OCTOBER 29th, 1960

7 Mansfield Street,
London, W.1.
Museum 6541

Congress Papers

SYMPOSIUM ON BRUCELLOSIS*

(1) The Prophylaxis of Brucellosis in Cattle

BY

A. McDIARMID

**Agricultural Research Council, Field Station,
Compton, Berkshire**

SUMMARY.—A general description is given of prophylactic measures for the control of brucellosis; the difficulties of maintaining a susceptible non-vaccinated herd free from the disease are stressed and the method of control by blood testing is compared and contrasted with the general policy of vaccinating with S.19 with or without the elimination of infected animals. Consideration is also given to the part which local surveys of the incidence of the disease might play in assessing from time to time, the effect of the vaccination programme on the control of the disease; the advantages which would be associated with the use of a non-agglutinogenic killed adjuvant vaccine are also mentioned. It is suggested that economic loss associated with brucellosis has been largely masked by widespread vaccination and that this loss may be greater than is realised at present.

IT is well recognised that brucellosis in cattle may be controlled either by the detection and disposal of infected animals and the protection of the remaining susceptibles against further infection or by an immunisation policy with a suitable vaccine. Moreover, in recent years, a combination of these two procedures has been employed with considerable success, particularly in some Scandinavian countries where eradication of the disease has been the aim.

Detection and Disposal of Infected Animals

This procedure, as many of us know from experience, is fraught with many hazards and at the present time the incidence of the disease in this country has not yet dropped to a low enough level to permit the adoption of such a method of prevention except under certain well-defined circumstances. At Compton, because of the need for a supply of susceptible animals for immunological experiments 3 normal herds of fully susceptible cattle are maintained. These herds are blood tested at 3-monthly intervals, in a search for any trace of agglutinins. Sometimes non-specific reactions present a problem, but generally speaking this method of detection is satisfactory. In addition, all abortions and premature calvings are checked bacteriologically. So far, over a period of 20 years, despite all these precautions, we have encountered 3 sporadic outbreaks of brucellosis in our herds. It is, perhaps, worth emphasising that these herds are self-contained. There was no possibility of infection being introduced by purchased stock. I mention this because, nowadays, owners display a false sense of security when discussing this problem, firmly believing that there is little or no risk to their herds provided no fresh stock is introduced. The first outbreak in 1941 occurred at our Superity farm where several outlying in-calf heifers reacted to the blood test. These were immediately destroyed and no further cases appeared in this herd. The precise source of infection was never established. The second outbreak occurred in 1944, when owing to a gate in a right-of-way having to be opened to preserve the public right, infected heifers from a neighbouring farm gained access to our Cheseridge herd. This occurred at night and although the trespassers were removed immediately next morning, the damage had been done and, despite weekly blood testing and the elimination of reactors we were unable on this occasion to check the spread of infection by this method. Consequently, a temporary vaccination policy was introduced. Apart from the bulls and calves under 4 months of age every animal in the herd was vaccinated with S.19 and thereafter the next calf crop was dealt with in the same manner. Meanwhile any known infected animals were eliminated. No more vaccination was practised and we proceeded

* Symposium of papers presented at the Annual Congress of the British Veterinary Association in Glasgow on Monday, August 29th, 1960.

to re-build a non-vaccinated herd. The financial loss in both these outbreaks was considerable as many valuable cattle were destroyed, and much time and effort were spent in trying to curb the spread of infection. Still more recently, in the spring of this year, we encountered our third outbreak, this time in our Ilsley herd. This, from the nature of its onset, could have been much more serious. One of our neighbours keeps beef cattle, calving out of doors on downland pasture. This herd, which was not vaccinated, had become heavily infected, several abortions having occurred in the preceding months. The first indication of infection on our own premises was the detection of a reactor in the Ilsley herd. On further enquiry this animal was found to have calved later than expected, the gestation period being 293 days. The membranes were retained but apart from this there was no clinical abnormality. Mucus from the genital tract contained *Brucella abortus* and the milk was infected. The cow calved 14 days before the routine blood test in a yard full of susceptible pregnant cattle. The infected animal was destroyed as well as its calf .and weekly blood testing was introduced. The yard in which the infected calving took place was restrawed to a depth of about 2 feet over the existing bed. This was repeated a week later. A thorough disinfection of the area of the shed where the animal had been milked was carried out also. At the time of writing the blood test had detected 3 more infected cows before they aborted. Fortunately, suitable isolation accommodation is available for such an emergency and any cattle positive or even doubtful to the blood test were removed from the herd forthwith. One of the 2 animals aborted in the isolation unit the day after removal from the herd. We hope to be able to eliminate this infection without recourse to vaccination but many months must pass before we can be sure of this having been accomplished. There was no question of direct contact infection in this instance; several fields separated the 2 groups of cattle and circumstantial evidence was strongly in favour of foxes being responsible for bringing in the infected material.

I have mentioned these three outbreaks in some detail, to try to emphasise the ever-present danger of maintaining non-vaccinated or partially vaccinated herds, a danger, I am sure, not appreciated by many farmers. Such outbreaks on an ordinary commercial farm, without the facilities which we have for the speedy detection and isolation of infected stock, might well have caused considerable financial loss. For example, under normal farming practice, the first infected cow in our last outbreak would not have been detected in the first instance and infection would not have been suspected until further clinical cases occurred in the remainder of the stock.

It is clear therefore that there is *still* some considerable risk in maintaining a susceptible non-vaccinated herd in this country, as infection may be introduced by means over which the farmer has no control and thus vaccination remains, by far, the best method of combating this disease apart from exceptional circumstances such as exist at Compton. Herds from which cattle are exported to countries whose import regulations prohibit the entry of vaccinated stock require special consideration.

Vaccination

In the past many different antigens have been employed for the prevention of brucellosis. In the 'thirties, virulent and avirulent living vaccines were commonly used; in the 'forties, killed vaccines of various types, whole cultures and "fraction" antigens, were examined for their immunising ability both under experimental conditions and in the field and strain 45/20 (McEwen) offered hopes that a non-agglutinogenic living vaccine with an immunising value almost equal to that of S.19 might be the answer to the problem. Unfortunately, McEwen's strain was shown, under experimental conditions, to be capable of altering in character and becoming fully virulent especially in the pregnant cow in complete contrast to S.19 which has remained remarkably stable since its original isolation in the U.S.A. Accordingly, in this country, work was concentrated chiefly on the latter strain as, although other killed vaccines of various types were examined both here and abroad, none was found which equalled, let alone surpassed, S.19 as an immunising agent. Recently, following the preliminary work of McEwen and Samuel we have again turned to the possibility of developing a killed non-agglutinogenic adjuvant vaccine which might equal S.19 in immunising ability. For the present, however, there can be no doubt that S.19 is the most efficient antigen we possess and that, under most circumstances, its use is essential for the control of the disease; one cannot expect S.19 to eliminate the disease completely but, if properly applied it can reduce the abortion rate to a level of about 2 per cent. This level, incidentally, may be present in non-infected herds and represents abortions due to a variety of causes quite apart from brucellosis. Effective control of the clinical disease has, however, created a certain amount of apathy on the part of the farming community so that, nowadays, without further encouragement, little or no additional effort is being made to get rid of infection from the herds. A "carrier" state may thereby be established and, in some instances, a public health problem created by the presence of field strains of *Br. abortus* in the milk. On rare occasions the infection rate continues to rise until eventually abortions occur, which stimulate the farmer to seek further advice.

During the 'fifties a considerable amount of evidence accumulated concerning the degree of protection afforded by vaccination; under experimental conditions at Compton we expect about 80 per cent. protection against a light, but effective challenge dose. If, however, the challenge is increased tenfold, perhaps only 50 per cent. of the cattle will be protected against infection. This seems to emphasise the danger of vaccinating stock under field conditions without trying also to curtail the amount of infection in the herd. If heavy infection is allowed to persist, the results of vaccination may well be disappointing. This is, however, a rare occurrence nowadays and under field conditions a protection rate of 90 per cent. may be expected. The 5.0 ml. dose of vaccine

is purely an arbitrary choice which allows for a considerable margin of error. Experimentally, we have reduced this amount to 0.2 ml. and still obtained good results although the number of cattle used was small. The actual route of inoculation does not appear to matter, since comparable protection has followed the application of vaccine either subcutaneously or intradermally.

Degree of Protection Conferred by S.19 Duration of Immunity

There is good evidence from experiments, both in this country and the U.S.A., that calfhood vaccination with S.19 protects until at least the fifth pregnancy and probably longer. At Compton, an experiment was designed to test the degree and duration of immunity following a single calfhood vaccination versus multiple vaccination prior to breeding age. The experiment was started in 1949 and completed in 1956. It involved the use of 534 cattle. Although multiple vaccination appeared to be slightly better than single vaccination, the difference was not significant. It was also found that the immunity at the fifth pregnancy was not significantly lower than it had been at the first pregnancy. The slight benefit associated with multiple vaccination was completely offset by the persisting titres which, in adult cattle, greatly restrict the value of antibody tests for the identification of infected animals.

Adult Vaccination

Because of the results already mentioned it is clear that adult vaccination with an agglutinogenic vaccine such as S.19 should be discouraged whenever possible. There is no evidence that repeated vaccination in later life enhances or prolongs the basic immunity and when a so-called " breakdown " occurs it is caused, in most instances, by the increased weight of infection rather than by lack of protection by the vaccine or the presence of strains of enhanced virulence. The persistence of agglutinins in adult vaccinated stock always presents a problem when trying to detect infected animals and would be a complication in any eradication scheme. It is prudent therefore to restrict vaccination as far as possible to calves between the ages of 6 and 8 months. There are, of course, always exceptions to the general rule and adult vaccination is still justified in a recently infected non-vaccinated herd. Under such conditions grievous loss might be sustained if only calfhood vaccination were practised. A system of marking vaccinated calves would, however, help considerably to diminish the demand for adult vaccination. Many people vaccinate bought-in adult stock simply because they do not know if they have been vaccinated as calves or not. It is worth noting that on rare occasions S.19 will localise in the uterus of a pregnant cow after vaccination and abortion may occur. The risk is probably 1 to 2 per cent., small in comparison with the risk of leaving these animals unvaccinated in an infected environment. This fact probably accounts for the rare isolation of organisms resembling S.19 from the cyetic products of field cases.

General Control Measures

From what has already been said it is obvious that vaccination with S.19 by itself will not render a herd free from brucellosis. There is no doubt that the majority of animals will resist a light infection if they have been properly vaccinated, but not all are immune, and in view of recent findings, in the field and under experimental conditions, that local infection of the mammary gland in vaccinated animals by virulent field strains may occur, we should always consider the risk of such insidious spread in a vaccinated herd. Spread from udder to udder during the milking process is probably not a very serious problem but it can occur and there can be no doubt that a progressive owner should get rid of infected animals at the earliest possible opportunity to minimise the risk of further spread. This, unfortunately, is when one of the main difficulties in general prophylaxis arises. The problem is what to do with the infected animal. The average dairy farmer with a small herd has little option but to return the infected animal to the open market. The risk of buying infected cows is still present and all farmers would do well to consider the inadvisability of purchasing cows which have already bred; non-pregnant young stock are always a much better proposition.

Breakdowns in Immunity

While it is not always possible to determine the cause of a breakdown in immunity; I believe that some result from the progressive build-up of infection to a level at which S.19 will not protect. Frequently this is aided by the failure of the owner to ensure that all his calves are vaccinated. In this connection it is interesting to note that nowadays, probably not more than half the total heifer calves in the country are inoculated in any one year. Experimentally we know that approximately 80 per cent. of vaccinated calves can resist a light infection but when exposed to a heavy infection the protection may drop to 50 per cent. or less It is, therefore, unwise to place complete faith in the vaccine and to ignore entirely the reduction of infection on the farm.

Adjuvant 45/20 (McEwen) Vaccine

During the last few years experiments in mice, rats, guinea-pigs and cattle with a killed adjuvant vaccine prepared from strain 45/20 (McEwen) have indicated that such a vaccine can give good protection and further confirmatory work is in progress. In the initial experiments both at Moredun and Compton, " Falba " was employed in conjunction with liquid paraffin as the adjuvant—the organisms being killed by heat prior to incorporation in this base. The immunity conferred on small laboratory animals and cattle by this vaccine almost equalled that produced by living S.19. There was little or no difference in the mouse protection tests between these vaccines, but the guinea-pig trials, which are somewhat more sensitive, showed that this new killed adjuvant vaccine was not quite so effective as the living S.19. Two doses of vaccine were required in cattle but the resultant immunity appeared to be effective against a light challenge dose. The 45/20 vaccine had the

distinct advantage that it did not produce agglutinins in the immune animals which had resisted the experimental infection. Unfortunately, in cattle, "Falba" produced a persistent unsightly swelling at the inoculation site and consequently search was continued in collaboration with Glaxo Ltd. for a more suitable adjuvant. A substance, A2 is now being used in trials with killed 45/20; a good degree of immunity can be produced in small experimental animals, the local reaction in cattle is acceptable and, so far, no systemic reaction has been observed. Moreover, such a vaccine has little or no depressant effect on the milk yield of lactating cows whereas S.19 vaccine can cause an average loss of 24 lb. per head. An experiment, designed to measure the degree of immunity conferred by this new vaccine in cattle is at present in progress at Compton. It is too early yet to say whether or not this vaccine will find a place in the prophylaxis of brucellosis but if a dead vaccine that does not produce agglutinins, gives a satisfactory degree of immunity in cattle it will have much to commend it.

Charting Schemes

When considering methods for the control or eradication of a disease, it is desirable to measure as far as possible, the extent of the problem to be tackled. In the case of brucellosis, there is, so far, little exact knowledge about the level of infection and with a view to obtaining more information about this we have carried out a survey of the incidence of infection in Oxfordshire and the Isle of Wight with the following results:—

	Oxfordshire	*Isle of Wight*
No. of farms examined	662	582
No. of farm found infected by biological tests	29	13

A further national survey is imminent and when its results are available it should be possible to assess the true nature and extent of the problem as a whole. Further general prophylaxis will, no doubt, depend to a considerable degree on the out-come of these investigations.

Economic Considerations

There is no exact figure for the loss caused to the dairy industry by contagious abortion and indeed, it would be extremely difficult to obtain. Undoubtedly, the loss has been diminished considerably by the introduction of S.19 vaccine and it could be reduced still further by more universal vaccination of calves.

About 10 years ago, a select committee in the U.S.A. estimated the loss per infected cow to be $70. No similar figure is available in this country but if we assume this figure as applicable here the loss associated with an affected animal would be about £25. This figure was assessed on a variety of factors such as abortion, infertility, loss of milk (about 20 per cent.), deterioration in general health and depreciation in capital value. Taking the figures in the Oxfordshire survey, if eventually, 10 per cent. of 1,200 herds, representing 24,000 animals, were found to have 5 infected animals per herd, then 600×£25 amounts to £15,000. The population of dairy cows and milking heifers, excluding beef cattle, in England and Wales is 2.6 million therefore if the infection rate is comparable with Oxfordshire and the average herd is comprised of twenty cows, then the total loss for that part of Britain would be 130,000 × 5 infected animals which would amount to 650,000 × £25, or £16,250,000, a formidable figure.

Finally, this makes no allowance for the public health problem of at least 1,000 cases of brucellosis per year, which, because of the nature of the infection, can cause a considerable loss of man hours and no small discomfort to the individuals concerned.

Conclusions

1. Present evidence indicates that extension of calfhood vaccination so that it becomes universal would be a major step forward in reducing the incidence of infection of cattle with *Br. abortus*. Effective identification of vaccinated calves would be helpful in such a project and practising veterinarians could do much to implement it.

2. Wherever circumstances permit, it is prudent to confine vaccination to calves between the ages of 6 and 8 months:—

(a) because immunity at the fifth pregnancy after calfhood vaccination is not significantly lower than it was at the first pregnancy.

(b) because re-vaccination with an avirulent live vaccine does not enhance the immunity sufficiently to justify its adoption in practice.

(c) in the event of it becoming possible to adopt an eradication policy, the presence of agglutinins in adult animals would have much more meaning than it has to-day and it would be helpful in detecting infected animals.

(d) if adult animals in vaccinated herds are known to be heavily infected, it is good policy to have them eliminated, where possible, in order to reduce the risk of "vaccination breaks."

3. Experiments are in progress to determine if a dead adjuvant vaccine prepared from strain 45/20 (McEwen) can produce an immunity in cattle that approaches or equals that produced by S.19. Such a vaccine does not stimulate the production of agglutinins and preliminary results in mice, rats, guinea-pigs and cattle indicate that it is a good antigen. Confirmation of this is very important.

A Selection of Publications for Further Reference

Details of Progress in Control and Eradication in other countries — STABLEFORTH, A. W., & GALLOWAY, I. A. (1959). Infectious Diseases of Animals. I. p. 108. Butterworths Scientific Publications, London.

The Stability of the Characters of S.19 and 45/20 — MINGLE, C. K., MANTHEI, C. A., & JASMIN, A. M. (1941). *J. Amer. vet. med. Ass.* **99.** 203. TAYLOR, A. W., & MCDIARMID, A, (1949). *Vet. Rec.* **61.** 317.

(*Concluded at the foot of page* 921)

(2) Brucella Eradication Schemes in Northern Ireland

BY

W. R. KERR

Veterinary Research Division, Ministry of Agriculture, Northern Ireland

SUMMARY.—In 1957-8 a Brucella *survey of Grade A herds was carried out in Northern Ireland partly dictated by the presence of a public health problem, and was followed in 1959 by an eradication scheme of these herds.*

This contribution is a record of the progress of such a scheme with a discussion of the diagnostic problems, and, to a lesser extent, of the husbandry and technical difficulties encountered. Emphasis is placed throughout this paper upon the major problem of the indiscriminate use of S.19 vaccine in mature and late calfhood animals and the resultant persistent blood titre found in many of these herds.

At this stage of the scheme the control of the negative herds and of herds found to be infected and now approaching a clean status has been successful and is discussed and tabulated.

The extension of the scheme and the formation of a Register of Brucella*-free Herds on a voluntary basis to other attested farms in Ulster is also discussed, with an appendix of the necessary legislation.*

IT was suggested by the local secretary that the terms of reference of this contribution should be the problems and progress of a limited eradication scheme carried out in Northern Ireland, with further information as to the extension of the scheme and its appropriate legislation and, if possible, a few words on the economics of such schemes.

The first stage of this work was a survey of Grade A herds whose untreated milk was sold in bottles, a survey dictated in the first place by the public health problems associated particularly with this milk (Kerr *et al.*, 1958), since the remainder of the milk sold in Northern Ireland was 100 per cent. pasteurised at that time. This survey was followed up a year later by an eradication scheme on these herds, which was coupled at that time with the introduction of legislation amending the existing milk regulations in relation to the sale of this category of milk. In particular, the new regulations required farmers to produce certificates of freedom from brucellosis in respect of their herds by 1st May, 1961.

The basis of this contribution is, therefore, the problems associated with, and the experience gained in, the cleaning-up process. The vast amount of work involved in this scheme has been carried out in collaboration with my colleague Mr. J. E. F. Rankin.

Eradication poses certain problems peculiar to brucellosis which are never fully recognised or appreciated until this type of work is carried out. A particular example is the failure to appreciate the existence of abortion-free vaccinated herds which are

The Prophylaxis of Brucellosis in Cattle.—*Concluded.*

*Degree and Duration of Immunity conferred by S.*19 *in cattle.* — McDIARMID, A. (1957). *Vet. Rec.* **69.** 877.

Loss of milk due to adult vaccination with S.19 — HOLMAN, H. H., & McDIARMID, A. (1945). *Vet. Rec.* **57.** 335.

The Excretion of Br. abortus *in the milk of experimentally infected cattle* — MORGAN, W. J. B., & McDIARMID, A. (1960). *Res. Vet. Sci.* **1.** 53.

*Vaccination of Pregnant Cows with S.*19 — McDIARMID, A. (1951). *Vet. Rec.* **63.** 265.

*Field Trials with S.*19 *in Britain* — LAWSON, J. R. (1950). *Vet. Rec.* **62.** 823.

Adjuvant Vaccines :

from smooth strains : — GILBERT, S. J. (1943). *Proc. Roy. Soc. Med.* **36.** 153.
McDIARMID, A. (1949). *Vet. Rec.* **61.** 305.

from mucoid strains : — FRAHM, H., & LEMBKE, A. (1955) *Zbl. Bakt.* 1 (*orig.*) **162.** 49.
(1955). *Zbl. Bakt.* 1 (*orig.*) **164.** 481.
McDIARMID, A. (1960). *Res. Vet. Sci.* **1.** 269.

from rough non-agglutinogenic strain 45/20 — McEWEN, A. D., & SAMUEL, I. McA. (1955). *Vet. Rec.* **67.** 546.
McDIARMID, A., & SUTHERLAND, F. B. (1957). *Vet. Rec.* **69.** 1,067.
PILET, A. H. (1959). *Bul. Ac. vet.* No. 5, 305.

Charting Schemes in Britain: Local incidence

Inverness — MARR, T. G., & WILLIAMS, H. (1958). *Vet. Rec.* **70.** 419.

Northern Ireland. — KERR, W. R., PEARSON, J. K. L., & RANKIN, J. E. F. (1958). *Vet. Rec.* **70.** 503.

Oxford and Isle of Wight — McDIARMID, A. (1960). *Vet. Rec.* **72.** 423.

Public Health Aspects — BOTHWELL, P. W. (1960). *Vet. Rec.* **72.** 425
DALRYMPLE-CHAMPNEYS, SIR WELDON. (1960). "Brucella infection and undulant fever in man." Oxford University Press, London.

Economic Considerations — U.S.A. Special Committee. (1949). quoted by STABLEFORTH, A. W., & GALLOWAY, I. A. (1959). "Infectious Diseases of Animals." Vol. **1.** p. 96.

yet *Brucella*-infected, and of the "shedding" carrier cows which are present in these herds.

The majority of problems, however, have been commonly experienced by countries which have eradicated this disease; but various factors influence the relative significance of these problems such as the density of the cow population, degree of milk production and the type of husbandry in force in the country concerned. Each country may place particular emphasis on certain problems. In our case the outstanding emphasis, without doubt, is placed on the problem of adult vaccination, a practice which has led to the accentuation of the persistent titre cow, which presents a major problem when the terminal stages of eradication from a herd are reached.

The first problem to be discussed is that of diagnosis. In an eradication scheme it is essential to locate the reactors as accurately and rapidly as possible so that they may be removed from the herd; to do this demands a sensible interpretation of the diagnostic tests. No one test can be used for this purpose. Workers in this field admit that there are shortcomings to all tests; it is therefore necessary that these should be discussed briefly in order to set the standards of interpretation used in our work.

The Diagnostic Tests

There is no single test that can be used reliably, since the interpretation of tests on any one sample must be influenced by the result of tests on other material from the same cow and of previous tests on the same material. The materials used in our complete test of a herd are blood serum, milk (as whole milk and whey), and mucus taken by the tube method from the anterior of the vagina.

The blood test

It is accepted that non-infected and non-vaccinated cows will not exhibit agglutinins in their sera; also that cows which have been vaccinated as young calves will in most cases not show a positive agglutination when they become adult. Titres fall at the cow stage to nil, 1:10, or partial 1:20, and as such are regarded as negative. On occasions a heifer may show a slightly higher titre.

Vaccine injected into an adult cow will result in a highly positive titre such as 1:640 or 1:1,280 which may suffer a gradual fall to 1:40 in 12 months' time. Cows injected for the second time will, however, show equally high titres but with the difference that they do not drop so readily and may remain constant at 1:80 or 1:160 for a much longer period. These titres may also show some degree of fluctuation.

The single blood test in the presence of vaccination has, therefore, a very limited application. Unless a series of blood tests of such animals are made to determine the possible loss of titre an accurate assessment of their status cannot be reached and even then doubt exists as to the titre being vaccinal or field strain in origin.

TABLE I
POSITIVE BRUCELLA HERDS APPROACHING A CLEAN STATUS

Herd number	Animals total	Total positives	Blood Positives	Milk positives	Mucus positives	Number of tests	Number of positives at first test	Number of abortions in 3-year period	Number of positives at last test	Persistent titre status per cent.
166	54	10	10	7	5	4	6	0	1	28
40	127	4	4	3	1	4	1	0	0	10
23	93	30	30	15	5	6	17	4	0	40
187	55	7	7	5	0	2	5	0	0	7
197	55	2	3	2	1	2	0	0	2	14
120	53	1	1	1	0	2	0	0	0	17
194	81	7	7	4	2	1	5	0	0	25
132	39	2	2	1	1	3	0	0	1	25
139	80	3	3	1	0	3	0	1	2	25
201	50	1	1	0	0	1	1	0	0	30
140	35	20	20	19	1	8	6	0	0	9
185	44	3	3	1	0	3	3	0	0	20
67	97	3	3	0	0	4	0	0	0	56
34	39	7	7	5	4	5	1	2	1	30
156	37	1	1	1	1	4	1	0	0	8
51	122	16	16	13	5	6	7	3	0	18
131	36	13	13	12	7	6	7	0	1	22
145	54	11	11	8	1	5	8	0	0	7
150	20	6	6	5	2	5	3	0	0	30
181	20	1	1	0	0	3	1	0	0	25
143	74	5	5	4	3	3	4	0	0	1
87	55	2	2	2	0	4	1	0	0	47
102	64	2	2	0	0	3	0	0	0	58
14	64	6	6	5	3	5	4	2	0	23
89	43	1	1	1	0	4	0	0	0	2
159	20	10	10	10	0	6	9	0	0	5
67	31	2	2	0	1	4	0	0	0	13
11	32	2	2	2	2	3	2	0	0	0
170	40	1	1	1	0	3	1	0	0	52
162	62	1	1	1	0	4	0	0	0	48
79	34	16	16	15	4	8	2	6	0	41
152	55	17	17	12	3	7	11	2	0	36

The milk tests

The milk tests are very useful as "moderators" when interpreting the blood test. In the scheme the milk ring test is used as a screening test and positives are then subjected to the whey test for a quantitative assessment.

From the point of view of diagnosis the milk test is most important, since the udder is the organ most commonly infected. Our tests and cultural examinations of the reacting cows in the scheme show that the ratio of infection of the udder to uterus is approximately 3 to 1. Another consideration is that Strain 19, when injected subcutaneously, rarely appears in the uterus or in the udder, therefore milk tests may be used with advantage to differentiate a vaccinal titre from that of a field infection. The field-infected cow will, in most cases, either show a positive milk or vaginal mucus, or both.

The milk tests suffer from one great drawback in that they are reliable only during what might be termed the period of normal lactation (Kerr *et al.*, 1959). Sero globulins bearing the sero agglutinins are present in the colostrum, and also make an increasing appearance in the last 6 to 8 weeks of the "drying-off" cow, particularly the in-calf cow, thus complicating the milk tests of adult vaccinated animals possessing a blood titre. For this reason, in the taking of milk samples the stage of lactation must be recorded in order that due allowances may be made, for example in the case of vaccinated late-lactation animals showing 1:10 and 1:20 titres in the milk and at the same time possessing a blood titre of 1:40. The dry secretion cannot be used as a means of agglutination test as it will definitely reflect the blood titre, but it can be effectively used for cultural examination of the *Brucella* organism. A much less important consideration is that cows recently vaccinated may show a temporary milk agglutination for a period not exceeding 6 weeks.

Vaginal Mucus

A *Brucella* infection in the uterus leads to locally produced antibodies in the vaginal mucus and to a positive agglutination test (Kerr, 1955). The advantage of its use is that a positive test almost certainly indicates that the uterus and its associated lymphatic glands are infected by a field strain. In addition, the test is less likely to be temporarily affected by cow vaccination. Its main disadvantage, however, may be seen from reference to Table I in the columns relating to milk and vaginal positives. This shows that with the activity of infection present in our herds, the udder is three times more likely to be infected than the uterus, and it follows that a negative mucus is not an indication that the cow is negative, but only that at the time of test the uterus is probably not involved. An individual negative mucus test is, therefore, of no value. Another disadvantage is that after the act of abortion the infection leaves the uterus and is seldom found in that organ after 4 weeks, but may return to the uterus at the next parturition. The mucus titre in some cows may persist for many months, but in other cows the titre is lost quite quickly and may become negative to the test. In most of these cows evidence will, however, be found in the udder which may persist for years. Vaginal mucus seldom reflects a low titre following recent adult vaccination providing the tampon method is not employed.

As a test it is found to be useful and is an essential adjunct to the over-all diagnosis of infected animals and may also be regarded as a useful moderator of the blood test. Additionally, this is our experience in carrying out this scheme of eradication in a cattle population which has been so subjected to indiscriminate adult and late calfhood vaccination that all three tests must at first be used to detect the infected cows and to evaluate the *Brucella* status of the herd. If no vaccination were practised then the blood test alone would be adequate as was the experience in Sweden.

The Incubation Stage

In our experience this constitutes one of the lesser problems; we may find one or more cows in a herd which have been infected early in pregnancy and which only become positive to the tests after they have calved or aborted. This has led us to make the recommendation to herd owners that when purchasing cows from non-tested stock they should be purchased only as newly calved cows or heifers and should be subjected at that stage to all 3 tests whilst they are kept in isolation. We strongly discourage testing of dry cows as a basis on which to purchase cows.

The Persistent Titre Cow

In the early stages of eradication in a herd the first step is the detection of definite positives and the removal of them from the herd; but at a later stage, particularly the terminal stage, the problem of the persistent titre cows assumes importance. As a problem it is almost confined to herds in which adult and late calfhood vaccination has been practised.

In herds with recent evidence of a field strain infection, a persistent titre cow is assumed to be one where there is a balance between the disease progressing and of its being completely overcome. In the vaccinated animal, the superimposition of a light infection appears to arrest the slow fall in the blood titre which should normally occur, with the result that the titre remains relatively constant for 12 to 18 months, without evidence of agglutinins in the milk or mucus. It is assumed, therefore, that in such cases the focus of infection is localised in some lymph gland. The majority of these animals would eventually lose their persistent titre without shedding the organism, but some after a long period of perhaps 2 years suddenly show a sharp rise in titre with evidence of the organism in the milk or uterus, or in both.

Very closely connected with the possibility of the latent infected persistent-titre cow is the state produced by vaccinating the adult cow with S.19. An initial sharp rise in antibody formation occurs following the multiplication of the vaccine organism in the body, but the titre may not fall so rapidly as in calfhood vaccination or reach as low a level. In some cows it persists at a high level, for example, 1:80 and over, and may even fluctuate at certain

periods, *e.g.*, at one test a rise of one or more dilutions may take place then the titre falls again at the next test. In some cases it does not fall and it is assumed that in these animals the organism has become established on an intra-cellular basis thus stimulating the persistent titre. One reason which we advance for this theory is that we have purchased and slaughtered 54 cows in this category and subjected them to an extensive cultural examination with completely negative results.

The authorities in the U.S.A. early recognised the problem of the persistent-titre reaction. Mingle (1955) stated that "the persistent vaccinal reactions resulting from over-age vaccinations have been a continuing source of confusion in herds when eradication measures based upon the removal of reactors to the blood agglutination test have been put into operation." To alleviate this problem they introduced a change of standard in their interpretations of the blood test. Briefly converted to our standards of test, an infected animal in non-vaccinated herds is regarded in the U.S.A. as giving a titre of 1:40 and over, but with the addition of a category related to officially vaccinated animals (that is, vaccinated as calves between the age of 6 and 8 months), they be not considered infected unless showing a titre of 1:80 or over when the age of the animal at time of testing exceeds 30 months.

Haring and Traum (1943) reported the persistence of agglutinations 2 years after vaccination in 752 animals divided into 5 groups as follows:—

Age Group	Persistence of Titre
4 to 6 months	Nil
6 to 8 „	10%
8 to 10 „	25%
10 to 16 „	40%
Over 16 „	85%

The level of persistent titre is taken as being the titre exceeding that of the negative vaccinate level of 1:40. The age of vaccination and persistent titre are thus most definitely related.

Mingle (1955) records in the U.S.A. that the temporary flare-up of vaccinal blood titres which takes place from time to time was a disturbing element and seriously interfered with their efforts to determine the exact *Brucella* status of the herds. Moreover, the interpretation of such tests was frequently in conflict with the requirements of the regulations.

In Northern Ireland calfhood vaccination is often loosely taken as any age up to 15 months or even just prior to mating. This practice leads to titre problems almost bordering on that of adult vaccination.

It is obvious, therefore, that indiscriminate vaccination is a major problem which must be vigorously faced before proceeding with an eradication scheme in an intensive dairy country. It is essential that all possible measures of disseminating the information against such practices be utilised, to get over to the veterinary surgeon and also to the farmer that only calfhood vaccination must be employed, and moreover that strict observance of the vaccination age must be adhered to. In Northern Ireland, farmers concerned with the scheme were early circularised regarding this regulation, yet many did not fully understand the regulation or follow the instructions seriously. This has led to confusion of the blood tests in the herds concerned.

The Testing Procedure—Grade "A" Herds

In the primary scheme a complete test consisted of samples of blood, plus milk and mucus samples taken from all cows and mated heifers when possible. For example, in dry cows udder secretions for reasons previously described are excluded from the milk test, and in the taking of mucus samples some difficulty with heifers may be encountered by inexperienced samplers.

If the test is considered free of reactors, the subsequent tests in the herd are confined to screening the herd at 3-monthly intervals with milk samples (M.R.T. and whey tests) from each milking cow and heifer.

If the herd shows definite reactors then the complete test is repeated at 3- to 4-monthly intervals until the herd is clean. Thereafter the herd is screened as before by the individual milk test. In infected herds the bull is also subject to test, blood and semen being used.

Testing Procedure—Brucellosis Register

As indicated below the primary scheme, which is essentially a public health control measure, is being augmented by the establishment on the part of the Ministry of a Register of Brucellosis Certified Herds. The latter scheme, which is open to all attested herd owners in Northern Ireland, necessitates the application of much more rigid interpretation standards. In the first place, 2 complete free tests are essential to qualify for the Register. The purchase of animals, vaccinations and movements must also be controlled. A summary of the regulations of the Brucellosis Register has been contributed by Mr. E. Conn, Chief Veterinary Officer and his staff, and is appended.

In certain herds when there is a persistent blood titre problem following adult vaccination, and when the herd history and adjunct tests indicate a freedom from field infection, a dispensation in the milk regulations is permissible. In these herds time must elapse to allow strictly calfhood-vaccinated heifers to come forward into the milking herd, and for the removal of remaining "chronic" persistent-titre animals before the herd can graduate to the Register. This dispensation is necessary to prevent hardship to farmers who have followed so properly the past advice of the profession, *i.e.*, to vaccinate cows and mating heifers

Discussion of Scheme

Negative Group

One hundred herds were found to be negative and formed the negative group. These herds from the commencement of the scheme, apart from the inherent vaccinal titre problem already discussed, have not created any serious problems. Four herds were found in subsequent tests to have single animal

breakdowns, one from the purchase of an untested cow, another from a positive cow not previously presented, and 2 from over the fence. In none of these herds has spread of infection to other cows in the herd so far been shown.

The farmer's somewhat casual attitude in general to schemes and regulations always constitutes a problem, and it is a factor that must be considered in a brucellosis scheme. Despite circulars and instructions, liberties are occasionally taken, sometimes with disturbing results.

Infection Groups

In the group described as herds approaching a clean status it is noteworthy that 80 per cent. have not shown a definite clinical picture of *Brucella* abortions, and on repeated tests have shown a total of 7 or less reactors (Table I). In this group the first stages of the eradication process were found to be not so serious as had been expected, and with the exception of a few herds the process was not associated to any extent with the problem of recurring reactors. Four herds showed a greater number of reactors than other herds, *i.e.*, between 16 and 30. Herd 140 was an interesting case, 20 positives out of a herd of 35, of which 1 was uterine positive and 19 milk culture positive; yet no abortions were recorded in this heavily adult-vaccinated herd. The clinical evidence in this herd of the order of infection, and its appearance as an udder infection, suggested that the milking machine was involved here as a spreading factor.

The last column in Table I is designated the "persistent titre status" and is determined by the number of blood titres in excess of 1:20. In most of these herds the titres arise solely from the results of adult vaccination, but in others there may be confusion with field strains, and time and further tests are necessary to clarify this position. Thompson (1950) found when young cows vaccinated as calves are exposed to infection 8.5 per cent. will react positively, 3.5 per cent. as the result of the calfhood vaccination, and 5 per cent. from exposure to natural infection. In our case the greater complication is that adult and not calfhood vaccination has been practised, which would suggest that the vaccinal titre percentage in Northern Ireland is much higher than in his recorded cases.

A further point is that in these herds in which the inactive stage of brucellosis is present, the spread within the herd has been neither rapid nor extensive. In 2 herds tested more than a year ago in which 10 and 12 reactors were found, the owners did not proceed with eradication at that stage, but recently have made a move to do so. The recent test showed that the original reactors were still there with the addition of only 1 and 2 new reactors.

It is interesting to note that the *Brucella* organism present in many of our infected farms is not typical of the classical strains, being less virulent; it has been typed as an aberrant G. strain. The column in the Table relating to abortions on farms has been culled from the farmers and cannot be taken as 100 per cent. factual, but may be taken to reflect broadly the clinical abortion status.

Table II—The Infected Group of Herds

These are herds which have not progressed in their eradication as far as the previous group for a variety of reasons—new entrants, lack of co-operation, or the extent of the infection in the herd. These are now being proceeded with.

Post-mortem Examination of Reacting Animals Taken Under the Regulations of the Eradication Scheme

In the initial scheme reacting animals were purchased from the infected farms and slaughtered mainly to prevent the spread of brucellosis to other herds by the sale of such cows which were not only reactors but often shedders of the organism. In the early stages almost 50 per cent. of the cows were shedders, but as the scheme progressed the number of shedders decreased very considerably, the majority of the reactors being classified as high bloods, or persistent blood titres at rather high levels, or showing undue fluctuations.

The *post-mortem* examination consisted of cultural and biological tests of submaxillary, mesenteric, supramammary and iliac glands, and from spleen and bone marrow.

TOTAL 131 COWS AND HEIFERS

Mammary agglut. pos.	culturally	neg.	...	30
,, ,, ,,	,,	pos.	...	28
,, ,, neg.	,,	,,	...	7
Mucus ,, pos.	,,	neg.	...	12
,, ,, ,,	,,	pos.	...	4
,, ,, neg.	,,	,,	...	3
Blood positive only ...	...	...	...	63
,, ,, ,, culture pos.	...	...	10
Total number of mammary pos.	...	...	65
,, ,, ,, uterine pos.	...	...	19

In no case was the organism isolated from any gland other than the supramammary and the iliac

TABLE II
INFECTED HERDS

Herd number	Animals total	Total positives	Blood positives	Milk positives	Mucus positives	Number of tests	Number of positives at first test	Number of abortions in 3-year period	Number of positives at last test	Persistent titre status per cent.
82	100	13	13	6	1	5	4	4	3	41
178	110	27	27	18	3	4	5	1	10	43
164	64	14	13	8	10	2	11	0	11	36
74	107	13	13	10	4	3	7	0	?	15

glands. Another feature was the 10 blood-positive animals from infected herds which were mammary and mucus agglutination negative on test prior to slaughter, and were found to be culturally positive. This feature is not of serious significance, being one of time factor only since the animals concerned would have become agglutinate positive at subsequent tests.

The Public Health Problem in Northern Ireland

Undulant fever became a notifiable disease in Northern Ireland from January 2, 1949, under the Public Health Regulations, 1948, and the notifications during the years 1949-1959 were as follows:—

1949	8
1950	6
1951	8
1952	4
1953	7
1954	4
1955	1
1956	13
1957	6
1958	5
1959	4

From the year 1952 onwards the great bulk of the public milk supply was pasteurised. Milk from Grade A herds, which represents only 7 per cent. of the liquid supply is, however, not heat treated. In these circumstances it is not surprising that the confirmed undulant fever cases have been rural in incidence: farmers and their families, dependants of farmers, and people visiting farms or in contact with farms. It is noteworthy that in the period of 1949-1959 no cases have been recorded in the City of Belfast (population 500,000). These figures would suggest that undulant fever cases will not be eliminated despite 100 per cent. pasteurisation until the incidence of brucellosis in the bovine animal is very much reduced and the "shedding" cow eliminated.

Discussion of Further Problems

The major problems of diagnosis, indiscriminate vaccination and the aberrant strains of the *Brucella* organism have already been discussed, but there are lesser problems to be faced in an eradication scheme. The first of these is the laboratory requirements for any such scheme. In our case, with a technical staff of 3 allocated for this purpose, we accept as a yardstick for an average week's work 800 bloods, 500 milk and 200 mucus samples. This converted to a herd basis would be 5 herds with an average of 80 cows per week. Milk samples are much the easiest to test and a great number of these could be done were they the only samples to be tested; but as has been stressed earlier, it is our opinion that all 3 tests must be carried out in the preliminary testing and in the subsequent tests of infected herds. In addition to the carrying out of the day-to-day tests, the technical staff is responsible for the despatch of labelled sample bottles and tubes to the field officers and veterinary surgeons. Further, we find that the interpretation and reporting of these tests is a time-consuming factor, particularly when dealing with infected and suspect herds. Not only have the previous tests to be consulted, but the vaccination history and the stage of lactation in the case of milk samples have to be assessed, and finally arrangements must be made for the retesting of doubtful animals.

At the moment the owners of a large number of herds have made application for entry to the voluntary scheme which soon will create a demand for additional laboratory space. This is the obvious bottleneck in a *Brucella*-eradication scheme, but is an administrative problem.

We must also look at the vaccination problem from another angle. We have stressed the necessity for strict calfhood vaccination and the reasons; but in the field a rigid adherence to that schedule is difficult. The farmer calls in his veterinary surgeon perhaps twice a year to vaccinate, but due to procrastination on both sides the 6 to 9 months means plus 3 or more. A minor problem with us is that some farmers have progressed to the point when they purchase S.19 and vaccinate their own stock. It will be noted in our scheme that a practitioner is required to furnish a certificate of vaccination detailing age of calf and attested number.

We admit that S.19 as an organism appears to almost avirulent and non-invasive, but when injected into mature cows or in-calf heifers it may be isolated from the udder and uterus (Haring & Traum, 1937). It has been our experience on rare occasions to isolate it both from the udder and uterus, a finding that is not perhaps of great significance. What is significant, however, is that live S.19 when injected into the mature animal may induce a varying degree of chronic brucellosis without evident clinical manifestation other than a titre which simulates that induced by a more virulent infection. Perhaps it is a moot point whether the persistent titre originates from field strain or vaccine and should be dealt with as a single but costly problem.

S.19 is not abortofacient, but in our experience some of the aberrant strains isolated by us have not shown a preference for the uterus, the udder being the organ of choice. Jacotot & Vallée (1959) in discussing the fact that S.19 sometimes causes bacteraemia in guinea-pigs state that some cows permit diffusion of the normally non-invasive organism. Another point they stress is that a large number of aberrant strains isolated from field cases of *Brucella* behave similarly to vaccinal strains when injected into guinea-pigs. This is our experience also.

Looking into the future, the use of a dead adjuvant vaccine with the properties of conferring some degree of immunity without inducing agglutinins, such as is being experimented with by Dr. A. McDiarmid of Compton, appears to be the complete answer to the greatest problem in a *Brucella*-eradication scheme.

The last reflection on our scheme is an optimistic one. *Brucella*, particularly in its inactive stage or in its aberrant form, can be controlled and eradicated relatively simply and at no great cost, providing that an adequate primary testing procedure is carried out, and we have not experienced any difficulties by reason of the herds being scattered throughout Ulster using ordinary fencing protection and agricultural practice. It is our considered opinion that the eradication of brucellosis from herds individually as well as collectively is a practicable proposition.

APPENDIX—BRUCELLOSIS ERADICATION

The object of the Brucellosis Order (Northern Ireland) 1960, is to encourage cattle owners to eradicate brucellosis (contagious abortion) from their herds. To that end the Ministry will keep a Brucellosis Register of herds which have successfully passed a series of tests for brucellosis, and will issue certificates to the effect that the disease has not been detected in these herds.

Farmers wishing to have their cattle entered in the Brucellosis Register are asked to do the following:—

1. Instruct their veterinary surgeons to test each animal in their herd for brucellosis. The test will involve the taking of samples of blood, milk and vaginal mucus from female cattle, and samples of blood and possibly semen from male animals.

2. If there are no reactors to this test an application and the veterinary surgeon's certificate should be sent to the Ministry of Agriculture within 4 weeks of the date of the test. The application is for registration of the herd in the Brucellosis Register.

3. The applicant will be required to give an undertaking that as from the date of acceptance of his application, he will observe the rules contained in the Order, namely, that he will:
   (a) keep records of every animal in his herd. The record must show the breed, age, sex, earmark or ear tag number, date of birth of each animal born into the herd, date of death or slaughter, names and addresses of purchasers, dates on which animals are moved to or from the herd, and date of vaccination with an anti-abortion vaccine approved by the Ministry;
   (b) mark each animal as may be required by the Ministry;
   (c) keep the boundary fences of his farm in good condition;
   (d) not bring milk or dairy by-products on to the farm for feeding for animals except from a herd in the Brucellosis Register. This restriction will not apply in cases where milk, etc., is in powder form, or is boiled or pasteurised before use;
   (e) notify the Ministry in the event of any animal aborting;
   (f) vaccinate with an anti-abortion vaccine approved by the Ministry all heifer calves between the age of 6 and 9 months, and will not (without the permission of the Ministry) vaccinate any other animals;
   (g) send to the Ministry the vaccination certificate;
   (h) not bring a bovine animal on to his farm (whether from another herd or from a show) except under movement permit issued by an Officer of the Ministry;
   (i) isolate, to the satisfaction of the Ministry, and dispose of any animal which has reacted to official test for Brucellosis, and disinfect premises in which the reactor has been housed.

Rules for the Movement of Cattle

A. In the case of an animal being moved from a herd already in the Brucellosis Register or from a show or sale at which cattle from brucellosis (certified) herds have been specially accommodated, the movement permit (see paragraph (h) above) will require that

1. the animal during the course of movement must not come into contact with any other animal not being moved under a similar permit;

2. the road vehicle used for the conveyance of the animal has, immediately before its use for that purpose, been thoroughly sprayed, cleaned out and disinfected with a 5 per cent solution of standard phenol (rail vehicles require similar cleansing and disinfecting);

3. water, if required by an animal during transit, must be supplied in a clean bucket and must be obtained from a source to which other livestock have no direct access.

B. In the case of an animal being moved from an attested herd not in the Brucellosis Register or from a show or sale of attested animals, the movement permit will require (in addition to the conditions in A above) that the animal be isolated on the buyer's farm and tested for brucellosis by a veterinary surgeon within 14 days of purchase. If the animal is less than 3 months old, it will have to be isolated until it reaches the age of 3 months and must then be tested. In either case the veterinary surgeon's certificate must be sent to the Ministry's Divisional Veterinary Officer in the district concerned and the animal may be retained as a permanent addition to the herd only if the test shows no evidence of brucellosis.

Ministry's Functions

On receiving an application for registration, the veterinary surgeon's certificate and the signed undertaking, the Ministry will arrange for a series of official tests to be carried out on the herd. The minimum period between each test will be 90 days.

Brucellosis Register

When no reactor is revealed by either of 2 successive official tests, the Ministry will enter the herd in the Brucellosis Register and will issue a certificate to the herd owner as evidence that brucellosis has not been detected in his herd.

Cancellation of Registration

The Ministry will continue the periodic testing of herds in the Brucellosis Register and may cancel the registration if any reactor is thereby revealed. Registration of a herd may also be cancelled if, in the opinion of the Ministry, the owner fails to observe his undertaking or any condition contained in the Order.

Re-application for Registration

Any herd owner who fails on his first application to have his herd registered in the Brucellosis Register or, any herd owner, the registration of whose herd has been cancelled, may re-apply to the Ministry. The further application must be accompanied by the veterinary surgeon's certificate and undertaking described at (1) and (3) above.

General

The Ministry may not be held liable for any loss sustained through the death, injury or illness of any animal caused through the carrying out of any test.

The Order is intended to assist cattle owners to improve the health and value of their stock and can accomplish its object only with the fullest co-operation on their part.

References

KERR, W. R. (1955). *Brit. Vet. J.* **111.** 169.

———, & RANKIN, J. E. F. (1959). *Vet. Rec.* **71.** 224.

———, PEARSON, J. K. L., & RANKIN, J. E. F. (1958). *Ibid.* **70.** 503.

———, ———, & ———. (1959). *Brit. Vet. J.* **115.** 4.

MINGLE, C. K. (1955). British Veterinary Congress.

THOMPSON, W. M. (1950). *Hoard's Dairyman.* 510.

HARING, C. M., & TRAUM, J. (1943). Proc. 47th Annual Meeting, U.S. Livestock Sanitary Association. 42-46.

———, & ———. (1937). *J. Agric. Res.* **55.** 117.

JACOTOT, H., & VALLEE, A. (1959). *Ann Pasteur Jan.*

(3) The Control of Brucellosis in Cattle in the Netherlands

BY

G. M. VAN WAVEREN

Central Veterinary Institute, Rotterdam

SUMMARY.—A survey is given of the development of the organised brucellosis eradication in the Netherlands.

THE Netherlands, the delta of the Rhine and the Meuse, is largely an agricultural country because of its soil condition. Nearly 60 per cent. of the cultivated area is grassland, which forms a fairly united plain, intersected only by roads, ditches and canals for traffic and drainage.

This situation has, from early times, given rise to the spread of a number of contagious diseases in cattle; and it is obvious that in such a united grassland area brucellosis also encountered few natural obstacles in its way. The cattle population on the farms in these regions is rather high, and this has been recognised as a factor that increases the chances of contamination.

In the Netherlands it is customary for cattle of different owners to be kept together in common pastures during the summer. Fatal to disease-control is our very intensive market trade, which weekly causes tens of thousands of head of cattle to change hands, exposing them to infection in cattle trucks and in markets.

When bovine tuberculosis control was progressing, plans were made to combat brucellosis, which was then assuming large proportions. In 1954 an extensive abortus ring test on samples of can-milk delivered to dairy factories, showed that about 30 per cent. of the Dutch cattle farms were infected with brucellosis, this percentage rising to 36 in the grassland areas. The annual direct damage caused by this disease was estimated at about £3m., which is a multiple of the losses suffered from bovine tuberculosis 10 years before. In addition to considerations of public health and the foreign demand for breeding cattle, meat and dairy products, it was the enormous direct damage which justified the starting of brucellosis control without delay. The control was organised by the Industrial Board for Agriculture, a public body established by Order in Council for the purpose of promoting the general interests of agricultural undertakings, entrepreneurs and farm labourers.

The industrial Board for Agriculture is statutorily concerned with all agricultural undertakings and every entrepreneur is obliged to observe its decrees, which require the approval of the Minister of Agriculture. The Board obtains the funds for the fulfilment of its task by imposing levies on all entrepreneurs or on groups of entrepreneurs. One of its duties is the promotion of the health of agricultural domestic animals and crops.

On the control of cattle diseases the Board is advised by the Committee for Animal Health, which has been set up by the Board itself. It is composed of cattle farmers, veterinary experts and representatives of the government. Control is carried out by the Provincial Health Services for Animals. They are administrative and diagnostic institutes, of which there is one in each province, and they assist the Board in drawing up decrees and act in accordance with the directives made for the whole country.

The above-mentioned bodies and institutes had already earned great credit in the control of bovine tuberculosis, which work they had completed with the aid of veterinary surgeons in 1956.

The provincial health services had at their disposal the full registers of the cattle breeds and the equipment for laboratory testing, while the veterinary surgeons had entered into a written agreement to carry out their share in the organised control in accordance with the prescriptions. This provided an excellent starting-point for a new job to be tackled by the services: the control of brucellosis.

The Basis for Control

Blood and Milk Tests

The great importance of serological diagnostics in brucellosis control calls for a survey of the various techniques used in diagnosis. Regarding the most usual tests, the tube-serum-agglutination test (Widal-Bang), it has to be remarked that it does not show the presence of incomplete antibodies and is subject to the prozone effect. These two disadvantages are considerably smaller with the plate test according to Huddleson-Carlson and, in consequence, its negative result is therefore highly conclusive. On the other hand, the plate reaction is more often non-specific than the tube test.

Owing to these compensating properties the serologic testing of all samples in the Netherlands is started with the technically simple plate test as a provisional selection of the negative cattle. The dubious or positive samples are then further determined by the tube test.

In the Netherlands much research work has been done on the complement fixation reaction. It was already known that this test has a high measure of specificity and gives few dubious results if the right amounts of serum are used and, further, that after the first infection it may become positive some days later than the agglutination reaction does, but it persists many months or even years longer. Thus the C.F.T. is suitable for tracing cases of chronic brucellosis. Perhaps of even greater importance is the experience that after vaccination during calfhood this test is mostly negative from 6 to 8 months later, often in contrast with agglutination reaction.

It may be assumed that this does not result from qualitative but quantitative differences of the antibodies, because the sera of cattle that have been subjected to several inoculations generally keep a longer

positive C.F.T. reaction. In a way, it is strange that the very useful properties of the C.F.T. should not have given rise to its use in mass-testing for brucellosis; this is probably due to the cumbersome nature of the original technique. Contributions from some of our research workers have simplified this test in such a way that since 1958 it is practicable for mass-testing.

The reactions are carried out in volumes of 1 ml. in plastic plates provided with bore-holes. All reagents are prepared centrally and are standardised at fixed values and sent in preserved condition to the laboratories of the health services. The reagents have been adjusted to a specific blood cell suspension, which is standardised on haemoglobin equivalent. The previous titration of the complement in the diagnostic laboratories has been abandoned. To check the experimental test, sets of 4 lyophilised standard serum samples (1 normal serum and 3 positive sera of different titres) are delivered in addition for daily use in the C.F.T. By this system one female laboratory worker can daily test 400 serum-samples for complement fixation capacity.

The C.F.T. is generally applied on sera that, according to the agglutination test, are dubious or slightly positive and whose titres are supposed to be caused by vaccination or non-specific reactions. To an increasing extent the test is also applied to negative blood samples, as experience has shown that older cows with negative agglutination titres can be brucella-carriers.

In special cases, to declare free or confirm the serological diagnosis in problem animals or herds, it is useful to make additional tests with the agglutination reaction at 56° C. and the Coombs test.

A titre reduction at 56° C. compared with that at 37° C. by more than 50 per cent. points heavily to the presence of normal agglutinins or a vaccine titre and, conversely, the maintenance or increase of titre to an infection. A negative result with the Coombs test proves freedom from brucellosis, whereas increase by more than 2 dilution degrees indicates infection.

The ABR test in milk enjoys a good reputation in the Netherlands because of its attractive simplicity, its great specificity and sensitivity. This sensitivity makes it reasonably suitable for testing can-milk samples. It is known that there are incorrect indications as a result of mastitis, shortly after calving, some weeks before making cows dry, and in milk poor in butterfat.

For further verification or explanation of the results on cow milk samples the same tests may be made as with blood testing: the milk plate test (at 56° C. better and more pronounced than at 37° C.), the C.F.T. (as specific as when used for blood) and the Coombs test (very important for the whey because of the more or less frequent occurrence of incomplete antibodies).

For the tracing of antibodies agglutination with vaginal mucus has produced good results, especially when carried out at 56° C. As no normal agglutinins are found low titres may indicate infection; account should also be taken of the possibility of a heavy prozone effect. The antibodies persist during long periods in the mucus of infected cattle, and therefore chronic infections may be traced with the vaginal mucus test. The demands on laboratory diagnosis will increase as control progresses, because the damage caused by a non-traced reacting animal will then be greater.

In the Netherlands the tests that are technically practicable and economically acceptable include the quarterly ABR test, the plate test for blood samples, the tube test for all non-negative plate reactions, the C.F.T. for all non-negative tube reactions.

This series of tests provides a very safe basis for organised brucellosis control.

Individual Control

Hygienic Measures and Vaccination

In the individual control or warding off of bovine diseases cattle farmers have for some decades made use of hygienic measures and vaccination. In various cases of infection and infection hazard the course of action to be followed has repeatedly been brought to the notice of the persons interested, both orally and in writing.

At first, particularly on infected holdings and in infected areas, hygienic measures and vaccination had to be combined to obtain a reasonable effect. In retrospect the impression is gained that extensive vaccination has favourably affected the situation in the large areas. However, without organised control throughout the country, by which also the purchase and marketing of cattle are safely regulated, hygienic and immunising measures are insufficient to free the Netherlands from brucellosis.

After 1945 inoculations were carried out with Strain 19, which was delivered in lyophilised condition and standardised at a live germ content of 60,000 to 80,000,000,000 per dose. For several years rather extensive mass vaccination was carried out, and though no complete figures are available for the whole country, we may safely say that more than 70 per cent. of the calves kept for rearing were treated.

For some years past, however, this percentage has greatly diminished and in 1959 an average of only 8 per cent. of the annual number of calves kept for rearing was vaccinated. The cattle farmers were free whether or not to vaccinate their cattle. They were, however, strongly influenced by the leading authorities who were against vaccination in free breeding areas, because the persisting agglutination titres after vaccination were a great impediment to the export of breeding cattle.

Organised Control

Initial Period, 1951-6

When an area was declared free from tuberculosis a start was made with organised brucellosis control. In Friesland, the well-known breeding area that has given its name to the black-and-white cattle breed, this stage was reached in 1951. In this province investigations had for some years been made to compare the indications obtained by the Widal-Bang reaction with the serum and the ABR test on the milk of individual cattle and can-milk. The results of these tests were fairly equal. For this reason, on the Danish pattern, can-milk samples were ABR-

tested to screen infected and non-infected cattle herds.

In anticipation of a nation-wide regulation the Friesian Health Service, in consultation with the national organ for the control of animal diseases (Committee for Animal Health), made some prescriptions for the participants in the voluntary control of brucellosis. The object of these prescriptions was to stimulate control by the introduction of a health certificate for sound cattle herds and the animals of which they were composed; additionally, reactors could be prevented from being put on the market, where they would cause an extensive spread of infection.

The participation in organised control was restricted to tuberculosis-free areas or associations (*e.g.* the district of a dairy factory), of which not less than 75 per cent. of the cattle farmers declared themselves prepared to observe the relevant prescriptions.

Farms of which the can-milk samples have produced a negative ABR test in 3 successive quarters of a year and of which the blood test of all the cattle upwards of a year old are also negative, are registered as free from brucellosis.

For such cattle, certificates stating freedom from brucellosis are issued on request.

The farms continue to be registered as being free as long as the quarterly ABR tests are negative and no clinical symptoms of brucellosis have been confirmed.

Farms that produce no milk or the milk of which cannot be sampled, may obtain the predicate "free from brucellosis" after passing 2 half-yearly blood tests on all cattle over 12 months old. To retain this status a similar annual blood test has to be passed. To these farms may be added only cattle from brucellosis-free farms. For service only bulls of "free" farms may be used, while the bulls of such farms may only cover cows free from brucellosis. In the event of any premature calving, material—such as foetus and milk—must be sent to the health service for testing. The cattle of such farms may not pasture with those of other owners, except with the consent of the health service.

Cattle below the age of 10 months may be vaccinated and only with vaccine prepared from Strain 19.

On "non-free" farms of participants in organised control, the infected animals are traced on request by means of the ABR test on milk samples and of the blood test. Cattle found to be infected may only be sold if they are offered as such: this is done by providing the tuberculosis certificate with a remark to the effect that the animal is not free from brucellosis.

Further, the infected farms must isolate the infected and aborting cows during, and some weeks after, calving. An aborting cow may be naturally covered only after 3 months.

The veterinary practitioners serve as advisers in the freeing of infected farms, and they are kept informed of the results of the relevant diagnostic tests by the health service.

When the Friesian control system had worked for some years, it was discussed on a national level and reviewed in 1954. It was changed on some points:—

It was left to the choice of the health services whether they would make 75 per cent. participation by the dairy farmers conditional to organised control. This made it possible to make milk and blood tests on cattle farms outside a given control area and to issue health certificates for these farms after their being freed.

The most important extension of the system was the inclusion in the registration of a second class of farms, of which the cattle herd had passed 3 successive quarterly tests on can-milk samples: they were given the predicate "ABR-free farm." When an animal from such a farm was sold, the tuberculosis certificate was imprinted with the remark "free from ABR," provided the animal concerned had passed a blood test shortly before the sale.

This extension in the issue of certificates was necessary during the middle of the period of control to make it possible to meet the requirements of healthy cattle.

Already, in an early stage, a high percentage of the farms had passed 3 or more quarterly milk tests, but the cumbersome nature and the high cost of individual blood testing hampered the increase in the number of brucellosis-free farms. The object of the new certificate was to give buyers of cattle a reasonable guarantee.

On May 1st, 1956, the number of ABR-free farms made up 62 per cent. of the Dutch cattle farms and the number of brucellosis-free farms 7 per cent.

The National Regulations for Brucellosis Control in 1957 and 1959

After the Dutch cattle herd had been declared free from tuberculosis in May, 1956, attention was concentrated on the control of brucellosis.

For the enforcement of its orders in the field of brucellosis control the Industrial Board of Agriculture required the co-operation of the provincial health services for animals. In order to guide the co-operation, the Board made a regulation for organised brucellosis-control which had to be followed by the health services. This regulation was, of course, based on the experience gained by the health services in previous years.

The *National Regulation, 1957*, contained some definitions and the conditions of certification and the models of the certificates.

Definitions

"Vaccinated cattle" are female cattle vaccinated at 120 to 270 days old with an approved vaccine, the vaccination having been registered by the health service.

Female cattle are considered "infected" when the ABR test in the milk is positive or the serological blood test produces a titre of 1:25 or higher (British titre 1:20).

A bull is considered "infected" with a serological titre of 1:10, unless this low titre is attended with a negative clinical, serological, and cultural semen test.

An "undecided reaction" is a serological reaction of 1:25 or 1:50 which, in the opinion of the health service is not based on a specific infection. Further tests must then lead to a definitive judgment.

A cattle herd is registered as "ABR-free," when the can-milk samples of all milk-producing cows have passed at least the 3 last quarterly ABR tests. In the last 6 months only cattle of recognised ABR-free or brucellosis-free farms may have been added, and no symptoms of brucellosis may have been confirmed in the herd concerned.

An "ABR-free cattle herd" is registered as "brucellosis-free" when all the cattle of the herd have passed the serological test: from this test are excluded the vaccinated cattle of less than 18 months old and the non-vaccinated cattle of less than 12 months old. Further, a herd is considered "brucellosis-free" when all the cattle have passed 2 serological tests at a 5-7 months' interval.

A brucellosis-free herd remains registered as such as long as the quarterly tests of the milk, or an annual blood test, are negative.

To retain their status as free from brucellosis, A.I. bulls pass a quarterly clinical, serological and cultural semen

test and an annual blood test with stricter requirements than for female animals.

Certificates for Cattle

The regulation contains 6 remarks to be stamped on the tuberculosis certificate in order to inform the buyer of the health of the farm and of the animal bought.

Of the greatest value is the "brucellosis-free" remark, which is issued by the health service for the cattle of a "brucellosis-free herd."

An "ABR-free" remark is made for the cattle of an "ABR-free herd," provided they have passed a serological test not more than 30 days previously.

For brucellosis-free and ABR-free cattle 2 further remarks may be made stating any vaccination against brucellosis with the date of vaccination and, possibly, the confirmation of a dubious titre, if any, after vaccination.

Amended National Regulation, 1959

On May 1st, 1959, an amended regulation for brucellosis control came into force.

On some points the 1957 regulation has been extended and detailed. It remedied the lack of uniform conditions under which cattle of different owners can be pastured together.

The complement fixation test is included in the regulation as a method to justify a small agglutination titre in a single animal in a sound herd.

As diagnostic tests are made by 11 health services, detailed instructions have been given on techniques and materials and the reading of the tests (ABR-test, plate and tube agglutination test, C.F.T.).

A guide has been issued for the judgment of the health of cattle of ABR-free or brucellosis-free farms whose sera have not, or not entirely, passed the tube agglutination test and the C.F.T.

For cattle that were vaccinated as calves less than 2 years previously, a dubious agglutination titre is no reason for rejection. When this titre remains constant and the C.F.T. is passed twice with an interval of about 2 months, these cattle are considered healthy and receive the predicate "cow with vaccination titre."

A dubious agglutination titre and a positive C.F.T. are a reason for rejection.

The combination of slightly positive agglutination titre and negative C.F.T. in vaccinated cattle is permissible, when the agglutination titre has fallen to dubious ("cow with vaccination titre"); such cattle are only marketable below the age of 2 years.

A dubious agglutination titre and a permanent negative C.F.T. of non-vaccinated cattle of ABR-free or brucellosis-free farms, which has been confirmed in a repeated test, gives rise to the remark "cow with a specific reaction." The animal is considered healthy, but may not be sold as such.

A dubious agglutination titre and a dubious C.F.T. in a repeated test, gives rise to rejection of non-vaccinated cattle, as does the combination of a positive agglutination titre and a negative C.F.T.; an animal with a positive agglutination titre and a dubious C.F.T. is rejected without further testing.

Bulls have to meet stricter serological requirements, a slight, but still negative agglutination titre being already a reason for further testing (sero-agglutination and C.F.T.).

Any slight agglutination in A.I. bulls in the prescribed quarterly agglutination semen plasm gives rise to further testing of this plasm (cultural test, C.F.T.). The yearly blood testing of A.I. bulls after registration as brucellosis-free was abandoned.

Acceleration of Control

Levies on Infected Farms

In 1957, when about 75 per cent. of the cattle farms were ABR-free or brucellosis-free, it was considered in what way to proceed with the control.

As may be expected in any voluntary disease control the cost of which is to be borne by the cattle farmers themselves, pressing or stimulating provisions were necessary for many groups of persons who showed little interest.

The leading authorities found that control should be intensified, but on such a basis that the cattle farmers would be able to free their herds gradually. To this end, after previous announcement in the spring of 1957, on May 1st, 1958, the Industrial Board for Agriculture promulgated the Bang's Disease Control Levy Order, which aimed at completing the eradication of the disease on May 1st, 1963.

The voluntary basis of control was now somewhat modified by the imposition on cattle farmers of a levy which would only be repaid to them if they had freed their herd from brucellosis within a fixed period.

The cattle farmer was left the choice between:—

(a) An obligation towards the health service to subject his cattle older than 18 months to an annual blood test, supplemented by an individual annual milk test. In this connexion he would have to pay an annual levy of about 10 shillings per head of cattle till his farm was free from brucellosis. The levies would be repaid if he had freed his farm within 5 years, that is to say before May 1st, 1963.

(b) He did not undertake the obligation of annual blood and milk testing. In this case he had to pay an annual levy of about £1, which would be repaid if he freed his farm within 3 years, or before May 1st, 1961.

No levies are imposed on herds that were free from brucellosis before May 1st, 1958, but in case of re-infection the levy will be repaid if the farm is re-freed within a new period to be fixed.

Re-infection through default, for instance as a result of the purchase of cattle without a certificate, is punished with annual levies that will not be repaid.

Already, one year after the entry into force of the Levy Order it is found that it works very well. In the period from May 1st, 1956, to July 1st, 1959, the percentage of freed farms ("ABR-free" or Brucellosis-free") had risen from 69 to 82.5. Blood testing increased considerably, so that about 75 per cent. of the Dutch farms received the predicate "farm free from brucellosis."

Situation May 1st, 1956	
ABR-free:	62 per cent. of farms.
Brucellosis-free:	7 per cent. of farms.

Situation July 1st, 1959	
ABR-free:	8.5 per cent. of farms.
Brucellosis-free:	74 per cent. of farms.

Over the whole country the infection percentage had fallen far below 10, in some areas even to 2.5 and for these areas it was considered desirable to slaughter the reactors left.

Prohibition of Keeping Reactors

The culling of reactors has been made possible by a regulation of the Industrial Board (May 1st, 1960) under which the Board may designate areas in which no infected cattle may be kept. The sale to cattle keepers outside these areas is forbidden so that the only course left is to slaughter the infected cattle. This must be done within 20 days of the date on

which the owners are informed of the positive brucellosis reaction in their cattle. The Health Service for Animals in Friesland was the first to make use of this regulation; on May 1st, 1960, it declared this enactment applicable. It is expected that in six months the same enactment will apply to half of the Netherlands.

In order to regulate properly the accelerated disposal of reactors to be expected in the approaching final stage of brucellosis control, a decree has been made applicable in a number of provinces (which, for the time being, will not yet be declared forbidden areas for reacting cattle), provided that additions to herds or common pastures may only be made with brucellosis-free or ABR-free cattle, and in some cases with non-pregnant cattle.

Decree on Hygienic Measures

In the initial period of brucellosis control the attention of the cattle farmers was drawn every year to certain hygienic measures which might make a great contribution towards the control of the disease. At first control on these measures was impossible, but in the later stages, when many farms had been laboriously freed from the disease and vaccinations were of rare occurrence, the farmers accepted them as indispensable.

By the end of 1959 it was provided that stillborn calves and aborted foeti should be delivered in watertight bags at the delivery stations of the destructors and that the afterbirths should be disinfected and buried deep in the soil, unless these materials were sent to the health services for diagnostic purposes. Infringement of this decree has been made punishable. The housing of cattle with retentio secundinarum is obligatory.

A few health services have made a degree for their respective provinces, by which occupiers of non-freed farms are only in special cases allowed to pasture their cattle; the movement of these animals was restricted.

Slaughter Premiums

In 1959 the Government, with a grant of half a million pounds, stimulated in the first place the freeing of farms re-infected before May 1st, 1960. After the first confirmation of re-infection the whole herd had to be blood-tested and the infected animals slaughtered within 20 days; a compensation of £25 per head is made. The infected cattle traced with subsequent blood testing are likewise compensated for, provided they are soon slaughtered and the farm is free from brucellosis within 2 years.

In the second place, the Government subsidy is used to stimulate the disposal of reactors on infected farms, on the understanding that infected cattle traced by the first blood test (before May 1st, 1960) are disposed of quickly and without compensation; the reactors traced subsequently must be slaughtered and when the farm is free within 2 years, a compensation of £25 per head is made.

With the aid of this fund more than 13,000 reactors were, within 12 months, disposed of through the slaughterhouses.

Preparations have been made to continue the compensation of slaughtered reactors from levies to be imposed on cattle farmers.

Conclusion

Now that in one province (Friesland) the control of brucellosis has been completed (after May 1st, 1960, it has been forbidden to keep reactors), it may be asked whether the method employed has been a good one.

It should first be noted that in the Netherlands brucellosis control has almost entirely become a voluntary activity of the cattle farmers and their organisations. The result of this might have been that eradication progressed very slowly; fortunately this has not been the case, for the end in view is sure to be attained for the whole country within 10 years from the start.

On their own initiative the farmers have favourably developed all the possibilities of their organisation. The advisory work, the prescriptions and the prohibitions came from their own association or organisation; prohibitions and levies were viewed in the light of regional possibilities and national desirabilities. In this way dislocation was prevented.

The cattle farmers in the breeding areas made an early start with brucellosis control because they appreciated their commercial interest. This created sources for the replacement of cattle and a stimulating example for the areas with store cattle.

The following Table illustrates the progress of brucellosis control in a breeding area (the Province of Friesland) from 1954 to 1960.

TABLE

BRUCELLOSIS CONTROL IN A BREEDING DISTRICT (20,000 CATTLE HERDS WITH 475,000 ANIMALS)

Herds certified as	1954 May 1st	1955 May 1st	1956 May 1st	1957 May 1st	1958 May 1st	1959 May 1st	1960 May 1st
	%	%	%	%	%	%	%
Brucellosis-free	5	6	7	10	37	79	94
ABR-free	43	53	52	51	43	10½	2
Infected	32	35	36	27	18	9	4
Not tested	20	6	5	2	2	1½	0
Vaccination of calves	85	85	80	45	10	3	3

As to the techniques of the disease control it may be remarked that the repeated ABR test is very useful. Three quarterly can-milk tests with negative results provided a reasonable guarantee that the farms concerned were free from brucellosis (ABR-free farms). On only 1 or 2 per cent. of these farms were one or more reactors found by subsequent blood tests.

The "ABR-free remark" (for an animal of an ABR-free farm and with a negative serum titre) has gained much credit in practice and will perhaps have to serve another year in the cattle trade. For the sake of certainty the general blood test should, however, form the final stage for every farm. The Dutch laboratories are convinced that, besides the agglutination reaction, the C.F.T. is often indispensable.

(*Concluded at the foot of page* 933)

(4) Epidemiology and Prevention of Human Brucellosis

BY

P. W. BOTHWELL

Department of Public Health, Bristol

Lecturer in Public Health, University of Bristol

SUMMARY.—An account is given of current information, drawn from various sources, on the incidence of human brucellosis in the British Isles; there is no evidence for diminution in incidence of the human disease recognised.

The endemiology of the condition is referred to in relation to studies carried out in this country, and the results of such studies indicate the importance of infection from milk, the rural preponderance of cases, and the endemic nature of brucellosis, which tends to occur repeatedly in the human population in some localised rural areas, where specific attention to the disease by public health and veterinary bodies should be concentrated.

The cause of death is reported in fatal cases occurring in the United Kingdom since 1949, among which were 5 cases of hepatic involvement, 2 of which developed cirrhosis; 2 cases of endocarditis, 1 with infarction; and 1 case of pulmonary embolism.

Although it is likely that an eradication scheme may be introduced in England and Wales and in Scotland, some time is likely to elapse before this is achieved. In the meantime, the legislation and official policy governing public health and veterinary aspects of brucellosis should be overhauled.

THE problem of human brucellosis in Britain is practically confined to infection with *Br. abortus*. Atypical strains of *Br. melitensis* occur in cattle but they appear to be of low pathogenicity for man and behave like *Br. abortus* in cattle. According to Stableforth (1960) these strains may, however, be on the increase. Only one case each of *Br. suis* and typical *Br. melitensis* infection have recently been reported in children (Williams *et al.*, 1957; O'Doherty, 1959).*

The symptomatology and pathology of the illness caused by these variants of *Brucella* are similar, though typical *Br. suis* and *Br. melitensis* infections are more virulent and have carried higher incidence of complications and mortality (Huddleson, 1947; Loeffler, Moroni & Frei, 1955; Spink, 1956).

Typical symptoms of the acute stage, in which there may be intermittent bacteraemia apparently unrelated to the pyrexia (Ganado & Bannister, 1960) are fever, sweats, aching, headache, prostration and weakness. Ganado and Bannister also emphasised the irregular nature of the temperature and in doing so have probably rendered a service to increased diagnosis. A protean variety of lesions and symptoms occur in chronic cases, which may be of long duration (Barrett & Rickards, 1953; Davies, 1957) and difficult to diagnose as brucellosis.

The *Brucella* organism is intracellular to the extent of being able to multiply intracellularly, although it is not an obligate parasite, and it tends to localise in tissues having an abundance of reticulo-endothelial cells. The granulomata formed by the body in localised lesions are unfortunately not pathognomonic, though suggestive (Barrett & Rickards, 1953). In some instances such localisation is associated with a suppurative process, involving the spine, meninges, liver, gall-bladder or other organs. The ability of the organism to multiply intracellularly may be important in relation to susceptibility to antibiotics and to the persistence of the disease in chronic forms; those antibiotics which are operative in the intracellular location are more likely to be effective. Treatment by antibiotics is more satisfactory than it was, but controlled trials do not appear to have been made and would be somewhat difficult to evaluate. Relapses after antibiotics still occur (Dalrymple-Champneys, 1960a; W.H.O., 1959).

The term brucellosis has in recent years replaced undulant fever and Malta fever, and is a more satisfactory term, since it covers both animal and human aspects of this zoonose, the prevention of which involves both the immediate safety (by pasteurisation) of milk supplies for the human population and the eradication of the animal disease in order to prevent infection by contact with animal excretions and by raw milk and raw milk products.

Br. abortus infection in the United Kingdom has

* O'Doherty's diagnosis of *Br. melitensis* was based on a titre of 1:10,000. As the organism was not isolated and typed it may not be entirely justifiable to accept this as the first case in this country, as suggested in the paper. It would be interesting to know if the organism was one of the atypical *Br. melitensis* strains increasingly being reported in this country. Broadbent (1931) also recorded a case in a child from which *Br. melitensis* was cultured (see page 937).

The Control of Brucellosis in Cattle.—*Concluded.*

Thanks to the early introduction of standard reagents and standard methods the disadvantages of the decentralisation of laboratory testing did not manifest themselves.

In the past few years the system of regulations has been tightened, which shows the serious attitude of the cattle farmers' organisations in this control. It is, too, an indication of the progress made. It is now very difficult to move cattle of an infected herd. In 3 years' time the national herd will be free of infection. Full credit is due to the cattle farmers, who have firmly tackled a job which they will certainly complete with guidance and the support of their veterinary experts.

been reputed to carry a mortality rate of about 2 per cent. and occurs at a frequency between 10 and 32 cases per million. Dalrymple-Champneys (1950) and Smith (1951) in their papers estimated the incidence to be in the region of 32 per million but the difficulty of making a diagnosis is a complicating factor in achieving a reliable estimation of incidence. The absence of notification in England and Wales and Scotland also makes even elementary statistics difficult to obtain.

Transmission of the disease to humans in this country is recognised to be predominantly by milk and by contact with infected secretions from animals. Other routes, like raw milk products, ingestion of infected meat and physical contact with infected meat by meat handlers, are probably not of very frequent occurrence in this country, although they have to be taken into account.

The epidemiology in this country, therefore, appears to differ considerably from that in the U.S.A., where contact infection is considered by Spink (1956) to be the commoner mode of infection, and he goes so far as to say that in one series infected milk accounted for only 12.7 per cent. of cases. Magoffin, Kabler, Spink and Fleming (1949) attributed 24.72 per cent. of their cases to milk infection.

The world literature on brucellosis is, of course, extensive, and for the purpose of this paper it is proposed to refer mainly to work in the United Kingdom and Eire, since this is obviously most relevant to the future control of brucellosis there.

The disease as it occurs in this country has been extensively described and recorded by Dalrymple-Champneys in his papers (1929, 1934, 1950, 1958) and particularly in his monograph, "*Brucella* Infection and Undulant Fever in Man" (1960a). The monographs of Huddleson (1947), Harris (1950), and Spink (1956) from the U.S.A., and that of Loeffler, Moroni and Frei (1955) from Switzerland are also authoritative and comprehensive; the latter is unfortunately still not translated into English.

Assessing the extent and importance of Brucellosis as a public health problem in the United Kingdom

Six questions have to be answered. (1) How many cases are there? (2) How serious is the infection? (3) Can these cases be prevented? (4) Is this worth doing from the preventive medical aspect or is it too small a problem for the effort involved? (5) How does such prevention interlock with veterinary and farming interests? (6) How much would it cost?

In attempting to answer these questions it is necessary to consider the incidence, the complication and fatality rates, the epidemiology, the adequacy of current legislation, the completeness of milk pasteurisation, and matters of liaison with veterinary and farming organisations.

Eradication of animal disease is largely a matter of veterinary concern. The cost of finally eliminating the human disease is equal to the cost of eliminating the animal reservoir, and this point is the subject of other papers at this meeting.

Current information on known incidence of cases and deaths

TABLE I
NOTIFIED CASES AND RECORDED DEATHS

		1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	Deaths Totals
England and Wales	Deaths	NK	1	2	1	3	0	1	3	0	1	12
Scotland	Deaths	0	0	0	0	0	0	0	1	1	0	2
Northern Ireland	Notified cases	8	6	8	4	7	4	1	13	6	5	
	Deaths	0	0	0	0	0	0	0	0	0	0	0
Eire	Notified cases	6	10	10	8	9	4	7	3	7	8	
	Deaths	0	0	0	0	0	0	0	1	1	2	4

Rates of Incidence (1958): Northern Ireland 3·57 cases per million.
Eire 2·67 " " "

The disease is not notifiable in England and Wales or in Scotland.

Absence from work on account of brucellosis

The Ministry of Pensions and National Insurance estimations of brucellosis morbidity are based on 5 per cent. and 10 per cent. sampling procedures which they apply to their data; their figures cover the working population, thereby excluding cases in childhood, in the majority of women, and in both sexes beyond retirement age.

Within the limitations imposed by a 5 per cent. or 10 per cent. sample in regard to a comparatively rare disease, the figures for brucellosis show no evidence of diminution, and in 1956-7 there were 100 male and 20 female spells of incapacity terminating within the period and 20 males incapacitated at the end of the period. Without knowing the hospitalisation of these cases or the length of the illness, it is not possible to estimate the cost of their treatment and incapacity. Similar reservations in relation to cost to the country must exist in the cases recorded by the Public Health Laboratory Service.

Further information available to the Public Health Laboratory Service and kindly supplied by Professor G. S. Wilson (1960) suggests that nearly all the town infections are caused by T.T. raw milk. There has clearly been little change in the numbers diagnosed

CASES DIAGNOSED *via* THE PUBLIC HEALTH LABORATORY SERVICE (ENGLAND AND WALES)

Year	*Cases*
1956	94
1957	90
1958	82
1959	88

Rate per 100,000	
County Boroughs	0·132
Municipal Boroughs and Urban Districts	0·141
Rural Districts	0·356

Ratio of Rural Districts to County Boroughs = 2·7 : 1.

via the Public Health Laboratory Service in the last few years and this is consistent with the apparent constancy of cases found over the years in recent surveys (Bothwell, 1960a), and Dalrymple-Champneys' (1960a) observation that he had noticed little change in the number of cases referred to him in recent years. Similarly, there is little evidence for diminution of brucellosis in the Ministry of National Insurance figures for sickness absence due to the disease.

The Public Health Laboratory Service figures also confirm the rural preponderance of cases; while the rôle of raw T.T. milk in town cases is in agreement with the findings in the Oxon survey.

The total of cases diagnosed *via* the Public Health Laboratory Service should also include cases where agglutination reactions or positive cultures have been carried out in hospital laboratories; but of course the diagnosis depends in the first instance on blood culture or blood sera being requested in a particular case, and it is in that part of the train of events that cases are missed. According to Wallis (1957), the number of cases missed is higher in childhood. In chronic cases other procedures may have to be used to diagnose the cases, since the sera agglutination and culture may well be negative (Barrett & Rickards, 1953; Davies, 1957). It is not, therefore, possible to say what proportion of the cases is diagnosed in England and Wales, and not at all unlikely that the known cases should be multiplied by a factor of 10 to get the real incidence.

The discrepancy between totals of cases recorded in various ways and the estimations made as a result of specific enquiries would seem therefore to result from: (1) many cases being unsuspected so that no tests are made. In this context the term undulant fever may itself be responsible for many cases being unsuspected. Braude (1955) and Ganado and Bannister (1960) have specifically drawn attention to the fact that the pyrexia may be quite irregular, absent or minimal; (2) such tests being carried out only once, or prozone phenomena giving a false negative; (3) the absence of positive agglutination in chronic cases and the need for other diagnostic tests to exclude the diagnosis; (4) incomplete statistics even of cases actually diagnosed.

Since 1 per cent. of the population have agglutinins in apparently normal health (Bothwell, 1960b), the organism has been "introduced" into 500,000 people in this country. If only one in 500 got the disease we might have 1,000 cases per annum. Since more concentrated exposure to brucellosis occurs in many occupations, it seems very likely indeed that missed and undiagnosed cases are indeed a real phenomenon.

Endemiology in the United Kindom

Survey of the literature covering series of cases

Much of the stimulus to investigation of brucellosis in this country must be attributed to the monograph of Sir W. Dalrymple-Champneys (1929). At that time only 14 authenticated cases of brucellosis had been reported in the literature as originating in England, three being from milk (one goat's) and all being *Br. abortus*. Contagious abortion in cattle was then reported to be extremely prevalent, 5.7 per cent. of single and 8.8 per cent. of mixed milk containing the organisms. The chronic carrier state due to *Br. abortus* was recognised, even when no abortion occurred, as was the difficulty in recognising human cases and the limitations of pasteurisation as the only means of elimination. He considered that the real incidence was in great doubt. In spite of the scarcity of brucellosis cases, the literature was nevertheless very extensive even then and Champneys gave 457 references in his 1929 paper, of which over 40 were British.

Wilson (1932), writing on the incidence of brucellosis in Great Britain and Ireland, considered that the disease was most common in adult males and that the vehicle of infection was usually milk or cream; also that about 500 cases of undulant fever would occur annually in England and Wales on the basis of serological investigations; at that time the incidence was higher in towns. (Dalrymple-Champneys considered this estimate too low and put the figure at 1,300 in 1950.)

Bigger (1931) found evidence of the presence of *Br. abortus* agglutinins in 20 per cent. of sera for Widal test, and in 2 per cent. the titre was 1:125 or above.

O'Callaghan (1931, 1932) dates European interest in Bang's bacillus from the work of Kristensen and Madsen, the latter drawing attention to Kristensen's work at the League of Nations Health Committee in 1928. An enquiry followed in Eire and in his 1932 paper O'Callaghan concluded that *Brucella* strains in Eire could cause fever and recognition awaited extensive enquiry; only *abortus* strains had been isolated from milk in Eire and the danger of unpasteurised milk remained. Though he did not consider the disease to be a serious menace, he thought emphasis should be placed on pasteurised milk and on hygiene for veterinarians and persons occupied in milk production. Only 2 known cases of *Br. abortus* infection had been recorded up to that time in Eire. 12 per cent. of 336 sera examined revealed the presence of agglutinins in titre from 1:25 upwards.

O'Callaghan in 1937 described a series of 21 cases from Eire, and reported that 20 cases had been described in Northern Ireland between 1932 and 1936.

By 1935 Dalrymple-Champneys had recorded a series of 255 cases.

Beattie, Smith and Tulloch (1935) described 97

cases of undulant fever occurring in Scotland between 1929 and 1934. Fourteen of these were deemed to be contact infections and the remainder caused by the consumption of infected milk. Their cases had complex symptomatology, a preponderance of cases among young adult males, and a male/female distribution of 59 per cent. to 41 per cent. when those subject to occupational risk had been excluded. Case mortality was 4.1 per cent. They considered that the milder forms of the disease would pass unnoticed. Children comprised 5.2 per cent. of their cases. Cases in Scotland had risen from three in 1929 to twenty-four in 1935.

Beattie (1938) considered the incidence of brucellosis in various groups of the population and concluded that *Brucella* infection in milk did not appear to be a very potent source of the disease, as only a few cases were reported and not many latent infections were discovered in agglutination reactions. Those exposed to contact with infected animals and meat (farm workers, slaughterers, meat packers) he considered were at greater risk than other workers and the members of the veterinary profession exposed to the greatest risk of all. He found that at that time 58.3 per cent. of post-graduate and 10.8 per cent. of undergraduate veterinary students had agglutinins to *Br. abortus* in their serum.

Paterson and Hardwick (1938) reported 8 childhood cases in whom the disease was described as mild, and considered that unpasteurised milk was the likely source of infection.

Elkington, Wilson, Taylor and Fulton (1940) described an outbreak of undulant fever in a school of 400 boys. There were 2 definite cases of undulant fever; 26 boys suffered from transient illness, 10 of whom had serum agglutinins ranging from 1/12 to 1/1100; and of 17 other boys with no symptoms 5 ranged from 1/20 to 1/1000. The milk supply was found to be infected with *Br. abortus*.

Cruickshank and Stevenson (1942) described 4 case of undulant fever in a girls' school evacuated from a large town to the country. The source of infection was unheated milk from a herd in which contagious abortion was present.

Leys (1943) described 8 cases of *abortus* fever. He considered that milk was almost entirely the source of infection, and that universal pasteurisation would eradicate it. Two of his cases occurred in patients under the age of 15, both of whom had meningism as part of the presentation.

Smith (1951) described the epidemiology of 285 cases diagnosed in the north-east of Scotland over a period of 22 years (1929-50). He found the average incidence over the last 12 years of this period was 16 per 500,000 per annum. The incidence in the urban area of Aberdeen was 2.2 per 100,000, compared with 4.1 per 100,000 in the country of Aberdeen. Male/female ratio was 1.7:1; the greatest incidence was among males in the age group 30 to 39; and the case mortality was 1.7 per cent. Housewives had the highest occupational incidence, followed by farm and dairy workers, followed by 10 individuals who also had close contact with animals and animal products. In a previous paper (1932) Smith had shown that 28 per cent. of all milk supplies obtained from individual farms contained *Br. abortus*, and in his paper of 1951 he considered that there was no evidence of any real decrease in the number of dairy farms affected by contagious abortion. Of his cases 2.8 per cent. were children.

Barrett and Rickards (1953) described 25 cases of chronic brucellosis. Fourteen of these patients were directly connected with either farming or marketing of dairy products; they all consumed raw milk but were also exposed to the risk of direct infection. The male/female ratio was 5.25:1, and there were twice as many patients in the age group 30 to 39 as in group 20 to 29. The district from which cases were drawn was essentially agricultural and the series formed part of a total series of 62 cases diagnosed there in a period of 18 months. Duration of disease was up to 15 years. Barrett and Rickards considered the problem to be one of national importance, since chronic brucellosis in farmers must be responsible for much low-grade ill-health. They drew attention to the lack of knowledge about the disease in Britain, and described the results of aspiration liver biopsy. At that time they thought there was a considerable prejudice against the use of pasteurised milk in that rural area and apparently a negligible proportion of the total milk consumed there was pasteurised.

Davies (1957) described 11 cases of chronic brucellosis which occurred in one rural practice in less than a year. Duration of disease ranged from 9 months to 10 years and only 3 cases had a positive agglutination when first tested.

Wallis (1957 and 1959) described 35 cases encountered in the course of 5 years' practice as a pediatrician, giving estimated incidence for active brucellosis of rather more than 1 per cent. of hospital patients. In 8 of his cases it was possible to trace the source of infection. He considered that the ingestion of raw milk was the source of infection in the majority of cases. Male/female ratio was 19:16.

Dalrymple-Champneys (1960a) considered there was evidence for infection from milk in 82 per cent. of his cases, irrespective of whether infection was from milk or contact. At all ages in his series the males outnumbered the females; the ratio was 1.85:1. In 124 of the milk infection cases, the milk consumed was from T.T. herds. Children comprised 10.3 per cent. of his cases.

White (1960), in surveying occupational hazards of practising veterinary surgeons in 25 practices, reported brucellosis in 4 principals, in 12 assistants and in several clients. The illness usually lasted 3 to 4 weeks. One principal was reported with chronic brucellosis lasting for 15 years and flaring up when S.19 spilled on the hands. "The reports of arm rashes after cleansing cows, probably an allergic response to *Brucella*, were much less common than in 1932, when information was collected from veterinary surgeons at the N.V.M.A. Congress."

Bothwell (1960a) described 61 cases in an Oxford survey covering 20 years (1939-58). The male/female ration was 1.8:1, and the ratio of rural to urban cases 3.5:1. The maximum age of incidence

was 21 to 30. About 80 per cent. of the cases appeared to be due to milk infection. The incidence in children (27.9 per cent.) was somewhat higher than in other series of cases and there appeared to be a diminishing male/female ratio in the second 10 years of the study. T.T. milk was incriminated in infection in a number of cases. There was evidence of endemicity of human brucellosis in several quite circumscribed rural areas, a series of cases occurring within them at intervals of a year or two.

There is a certain consistency in the findings of these various studies.

1. The majority of them indicate that milk is the major source of infection. The Barrett and Rickards series is an exception in that they had a majority of cases connected with farming, though many of these also drank raw milk. It may be that those in danger of repeated contact with infected animals are more likely to become chronically infected, though 9 of Davies's chronic cases were apparently not connected with farming.

2. There is a preponderance of rural over urban cases.

3. There is a preponderance of males over females.

4. Occupationally, however, those connected with dairy and farm occupations are more liable to be infected. (See also table below.)

5. Attention is repeatedly drawn to the ease with which cases can be missed.

6. In those studies where preventive measures have been advocated, pasteurisation of milk and the importance of the eradication of the disease in animals are emphasised.

AVAILABLE OCCUPATIONAL DATA FOR NOTIFIED CASES OF BRUCELLOSIS

	England* and Wales	Northern Ireland
	1957	1949–59
Farming	16	18
Schoolboys	16	1
Schoolgirls	8	—
Housewives :		
Farmers' wives	2	1
Others	4	11
Lorry drivers	4	—
Factory workers	3	1
Labourers (not farm)	2	1
Clerks	3	1
Shop workers	3	—
Building trade	2	—
School teachers	2	—
Students	2	—
Bank workers	2	1
Social workers	2	—
Veterinarians	2	1
Doctors and nurses	2	2
Publicans	1	1
Clergymen	1	—
Cooks	1	—
Managing director (cotton) ...	1	—
Seed merchant	—	1
Shoemaker	—	1
Water guard	—	1
Retired persons	3	1
Occupation unknown	8	20
	90	63

* Cases reported to Public Health Laboratory Service.

RURAL AND URBAN INCIDENCE, 1949–59

Year	Northern Ireland				Eire*			
	Total	Rural	Urban	Ratio R/U	Total	Rural	Urban	Ratio R/U
1949 ...	8	6	2	3 : 1	6	2	4	1 : 2
1950 ...	4	3	1	3 : 1	10	5	5	1 : 1
1951 ...	8	8	0	8 : 0	10	7	3	2·3 : 1
1952 ...	4	3	1	3 : 1	8	6	2	3 : 1
1953 ...	7	6	1	6 : 1	9	6	3	2 : 1
1954 ...	3	2	1	2 : 1	4	3	1	3 : 1
1955 ...	1	1	0	1 : 0	7	3	4	1·3 : 1
1956 ...	13	10	3	3·3 : 1	3	2	1	2 : 1
1957 ...	6	3	3	1 : 1	7	6	1	6 : 1
1958 ...	5	1	4	1 : 4	8	7	1	7 : 1
1959 ...	4	1	3	1 : 3	6	4	2	2 : 1
Total ...	63	44	19	2·3 : 1	83	54	29	1·9 : 1

* In the case of Eire some of the " Urban " figures relate to populations less than 2,000.

The Severity of the Infection

The complications which follow infection with *Brucella* organisms are a consequence of intracellular localisation, particularly in the reticulo-endothelial system, and of the formation of granulomatous lesions in various organs. Neuro-psychiatric disorders are the commonest sequelae according to Spink (1956), with involvement of bones and joints as the second most frequent, and these are most severe with *Br. suis* lesions (Loeffler, Moroni & Frei, 1955).

Cardiovascular and hepatic lesions also appear to be common complications, and in Dalrymple-Champneys (1960a) series of 24 deaths there were 5 cases of involvement of the liver, of which one had cirrhosis, and 2 cases with endocarditis.

Broadbent (1931) described a case in a child, in which *Br. melitensis* was cultured, which presented as a meningitis. Montgomery (1939) described a case in which myocarditis was a prominent feature and in which blood and sloughs were passed in the stools. Ley (1943) described psychosis, steatorrhoea, query pancreatitis, bacterial endo-

TABLE II

BRUCELLOSIS DEATHS RECORDED IN THE UNITED KINGDOM SINCE 1950

Year	Sex	Age	Occupation	Cause of death
ENGLAND AND WALES				
1950	F	63	Widow of coal miner	a. Myocarditis b. Abortus fever
1951	M	73	Master baker (retired)	a. Congestive heart failure b. Undulant fever
1951	F	75	Wife of gardener	a. Relapsing fever (brucellosis
1952	M	75	Clerk (Education Committee) (retired)	Ia. Cirrhosis of liver b. Infection II. Clinical undulant fever Senility
1953	M	65	Colliery shot firer	a. Hepatitis b. Abortus fever
1953	F	59	Wife of farmer	a. Cholaemia and uraemia b. Hepato-renal failure c. Chronic brucellosis
1953	M	58	Hay and straw merchant	Ia. Undulant fever II. Diabetes mellitus
1955	F	53	Independent means (Father : Income Tax Superintendent	Ia. Peripheral circulatory fever II. Abortus fever
1956	M	62	Coal miner	a. Liver failure b. Brucellosis
1956	M	60	Ship's donkeyman (Merchant Navy)	a. Septicaemia b. Undulant fever (brucellosis)
1956	F	47	Wife of farm worker	a. Cardiac infarction b. Bacterial endocarditis c. Brucellosis
1958	M	35	Farmer	a. Subacute endocarditis b. Brucellosis
			Sex ratio M : F = 7 : 5	
EIRE				
1956	M	43	Farmer	a. Cachexia b. Undulant fever
1957	F	40	Housewife	a. Anuria b. Chronic nephritis c. Brucellosis
1958	M	5	Father: Farm Labourer	a. Cardiac failure b. Undulant fever
1958	F	58	Housekeeper (rural area)	Ia. Exhaustion b. Abortus fever II. Arthritis
			Sex ratio M : F = 2 : 2	
SCOTLAND				
1956	F	63	Widow of gardener	a. Cirrhosis of liver b. Brucellosis
1957	M	26	Seaman, Royal Navy	a. Pulmonary embolism b. Abortus fever
			Sex ratio M : F = 1 : 1	

carditis, meningism and ocular palsy among his 8 cases. Branwood (1952) described meningitis, acute appendicitis, anaemia and splenomegaly.

Rennie and Young (1936) and Hart, Morgan and Lacey (1951) described cases of endocarditis; and Grant and Stote (1953) a rupture of the heart as a result of endocarditis due to *Br. abortus*.

In Smith's paper (1951) describing epidemiology of undulant fever in north-east Scotland, there were 6 deaths out of 285 cases, 5 of which could be directly attributed to *Br. abortus*. Two of these deaths were due to cachexia with repeated intestinal and other haemorrhages; 2 to ascites with cirrhosis of the liver; and 1 to pancreatic abscess and peritonitis.

Wallis (1959), in his series of 35 children, reported cases of non-specific arthritis, osteo-chondritis and radiculitis, haematuria, melaena, migraine, psychological disturbances and recurrent pyelitis.

Bothwell (1960a) in the Oxon series found 1 case of cirrhosis of the liver, 1 of rectal haemorrhage, 1 of haematuria, and 3 in which arthritis was present. There was 1 case of fatal pulmonary embolism.

The severity of the disease can also be judged to some extent from the duration of illness. In the two series of chronic brucellosis cases recorded by Barrett and Rickards and by Davies in this country, the long duration of symptoms has already been mentioned. Similarly, long duration of symptoms has been recorded by Dalrymple-Champneys in his series and also in the Oxon series of hospital cases.

In view of these complications and long duration of illness, it would seem worth while to make a standardised national follow-up of all past cases of brucellosis *via* local health departments or hospital out-patient departments, as there may be considerable chronic illness due to unsuspected persistence of brucellosis.

Table II lists fatal cases reported in the United Kingdom since 1949, from which it is clear that the complications described in the literature on brucellosis in this country are still in evidence. Hepatitis, for example, has occurred on 5 occasions (2 with cirrhosis), and there were 2 cases of endocarditis and 1 of pulmonary embolism. Of the 17 cases where occupation was ascertainable, 6 had some connexion with farming.

Prevention

The rôle of milk and the importance of pasteurisation

The percentages of milk now pasteurised in various parts of the United Kingdom are as follows:—

PERCENTAGES OF MILK SUPPLY PASTEURISED IN 1959

	Per cent.
England and Wales	94
Scotland	78
Northern Ireland	93
Eire: Dublin	87
Other urban areas	75
Rural (46 per cent. of population)	Nil

From these figures, Eire and Scotland might be expected to produce more cases per million than England and Wales and Northern Ireland. In England, with 94 per cent. pasteurisation, there seems to be no change in actual cases found over a 20-year period, although the volume of infection must be much less now than 20 years ago. That apparently as many cases of brucellosis occur now as previously may mean better recognition and more awareness of the disease, as well as continuing excretion of *Br. abortus* in milk. If everyone drank nothing but pasteurised milk, from 50 to 75 per cent. of human cases of brucellosis would disappear. This is true, but the fact is that many people still drink raw milk, particularly in the country, often straight from the farm, and the freedom of cities from infection contrasts with the present problem, when the incidence is predominantly rural. However, even in large cities like Bristol, about 6 per cent. of the milk supply remains unpasteurised, and about 140,000 gallons of raw milk was consumed in 1959, some from slot machine dispensers throughout the city, enough to give ample opportunity for brucellosis in a city. Clearly the distribution of non-pasteurised milk from vending machines must give quite a random possibility of infection with any *Brucella* that might be in that milk.

An analysis of liquid milk sales to consumers in the month of June, 1959 (Strauss, 1960), showed that 6.3 million gallons or 5.6 per cent. of total liquid sales in England and Wales consisted of milk which had not been pasteurised or sterilised, and almost all of this was raw T.T. milk bottled on the farm. Nearly three-quarters of it reached the consumer direct from the producer with the remainder being distributed through other trade channels.

At present the remaining producer-retailers are almost the sole source of milk for liquid consumption "fresh from the farm" and not subject to heat treatment.

SUMMARY OF LIQUID MILK SALES TO FINAL CONSUMERS, JUNE, 1959

	Million gallons			
	Total	Heat treated		Untreated
		Bottled	Bulk	
1. Producer retailers ...	5·0	0·8	—	4·2
2. Depots	0·9	0·7	0·2	—
3. Processing dairymen ...	73·9	70·4	3·0	0·5
4. Non-processing dairymen	33·2	30·2	1·4	1·6
Totals ...	113·0	102·1	4·6	6·3

The routine distribution of T.T. milk (some of which is raw) tends to occur more in some sections of the community than in others and tends to be associated with higher income levels (National Milk Publicity Council, 1958). The main markets for T.T. farm bottled milk are rural areas and suburban areas of large towns. The following is detailed information concerning social classes and income groups obtained during the 1958 survey described in the Council's booklet, "How Housewives buy Milk."

T.T. MILK RECEIVED BY HOUSEHOLDS FROM THE MILKMAN

	Total having milk (any type) delivered	T.T. milk excluding Channel Islands
		Per cent.
Total ...	1,757	26
Class :		
" Well-to-do " and " middle-class "	100	40
" Lower middle-class "	532	32
" Working-class " and " poor " ...	1,125	23
Income :		
Under £520 (head of household) ...	816	22
£520–£780	464	29
£781–£1,196	154	36
Over £1,196	61	56
No information	262	23

Clearly the continuing distribution of raw milk must be important when 11.3 per cent. of milk samples examined by the Public Health Laboratory Service (Redport, 1956) were infected with *Br. abortus*. McDiamid (1960a) considers that the true level of infection in herds examined in the Oxford series was between 4.4 and 8 per cent.

It is worth noting also that the total milk production in England and Wales rose from a 1938/39 figure of 1,080 million gallons to 1,813 million gallons in 1956/57, involving an increase in consumption per head from 3.0 to 4.9 pints per week during that period, and post-war consumption of milk per head was 65 per cent. higher than the pre-war figure. Such increases in *per capita* consumption of milk compared with pre-war days have some bearing, although perhaps only marginal, on the possibility of infection from raw milk for the remaining small percentage of the population who drink it.

Some Reasons for Persistence of Infection

Recently a cause of persistence of the disease in animals has been demonstrated by Kerr, Pearson and Rankin (1958) to occur in the process of milking; where vaccinated herds with little or no uterine infection are found to have considerable udder infection, this infection has occurred *via* the skin in the process of milking.

Recently, also, Dalrymple-Champneys (1960b) has referred to the appearance of *Br. suis* in hares in Denmark and to the rapidly spreading enzootics in swine traced to hares. He considers that this could have important epidemiological implications and speculates on the possible reservoir of the organism in wild birds and animals. Whatever the rôle played by such reservoirs, there is evidence that mechanical carriage of infected material by wild animals can transfer the infection, and McDiarmid (1960b) has referred to the rôle of foxes and even the transient straying of cows in introducing infection into clean herds on a field research station.

In this country there have been other reports on the possible carriage of *Brucella* organisms by various animals other than cows, sheep, pigs and goats. Menton (1937) found no positive agglutination in the sera of 200 rats and 100 poultry; nor from 21 groups of insects and 50 pond waters from infected farms (1940).

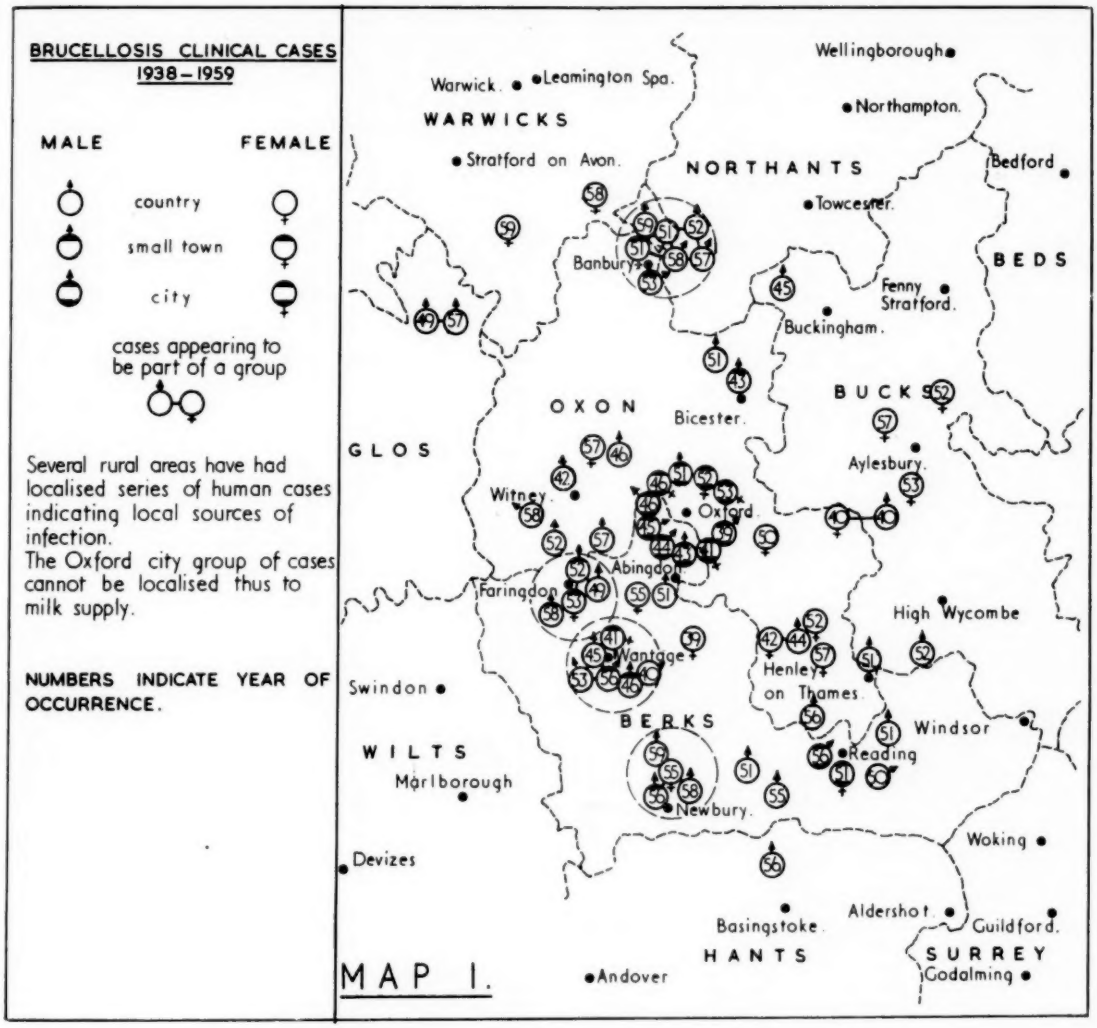
Bosworth (1937) concluded that the wild rat can become infected with *Br. abortus* by ingestion of contaminated food, that infection may pass from rat to rat when they are in close contact, and that the urine of infected rats may contain the organism and thus be a source of contamination of foodstuffs of other animals. From further work (1939) Bosworth found that the incidence of infection among rats in this country was low, the organism being recovered once only in 167 rats caught on infected farms. He concluded that there was, however, a risk of their acting as mechanical carriers since Sandholm had shown that the organism could pass through their alimentary canal and be excreted in the faeces several days after the intake of infected food.

McDiarmid (1951) found 5 positive agglutinations from 80 blood samples from three species of deer in the south of England. Subsequently (1960c) he examined a large number of hares (over 100) in the Compton area without finding serologic evidence of brucellosis. These were drawn from a restricted area and it would be worth while extending the search, particularly in areas known to have endemic brucellosis in cattle or other animals.

The other interesting practical aspect of the endemiology of human brucellosis is the evidence in the Oxon survey for the persistence of infection in distinct rural areas over quite long periods. There are several reasonably circumscribed areas from which human cases have been reported repeatedly, with perhaps a year or so between cases (see map). In one area, a series of cases has occurred from 1940 to 1956. This indicates that in these areas infection in the local herds, and consequently in the local population, is an endemic condition, and also that cases of human brucellosis, after the index case, might have been prevented by attention to the infected herds a long time ago. It may also be an indication that the eradication of the disease to a significant extent may be simpler than was thought. Certainly these areas should be ear-marked for attention to the infection possibility in animal herds.

In the follow-up of human infections, considerable assistance may be obtainable from the development of phage typing of *Brucella* organisms, so that the differentiation of *Br. suis*, *Br. melitensis* and *Br. abortus* can be assisted (Brinley-Morgan, 1960). This may be a method of increasing importance if *Br. suis* or *Br. melitensis* become established in this country.

Worth-while preventive work may thus result from following-up both the clinical human cases of infection and persons shown to have positive *Brucella* agglutinins. Persons in rural areas with positive agglutinins may of course be showing only the persistence of old infection. Nevertheless the persistence of the disease in rural areas makes follow-up worth while. An infected herd may be located, a pasteurisation order can be applied for immediate protection and measures can be taken by the farmer in conjunction with his veterinary officer to eliminate the infected animals. In view of the lack of impor-



tance attached to the disease in some quarters at the present time, this is not always a successful manoeuvre. If, however, this kind of practice were to follow the advent of a clinical case of infection in a human or the finding of positive agglutinins, a good deal of unobtrusive but effective cleaning-up of herds would accrue. This would be so particularly if restocking and calfhood vaccination were controlled, and if definite official policies were made known both to the veterinary profession and to public health authorities. In connexion with calfhood vaccination, McDiarmid (1957) has shown that one dose of vaccine during the 6th, 7th or 8th month protects the animal up to the fifth pregnancy.

Legislation

(a) *Control of milk and animal infection*

The legislation relating to the control of brucellosis so far as it concerns England and Wales consists of 5 provisions which have been referred to previously (Bothwell, 1960b).

This legislation is somewhat inadequate and out of date, but considerable improvement could be effected without waiting for a full scale eradication scheme. Primarily the regulations need bringing together into one piece of legislation which is simple and understandable. The Northern Ireland Milk Regulations (1959), designed for use in the Northern Ireland pilot eradication scheme, should be of use in revising the legislation, as would the WHO papers on this subject.

The Oxford technical group have recently considered these regulations and are forwarding recommendations on them to various bodies, hoping that perhaps they might revise, clarify and unify the several regulations governing the disease in man and animals.

Legislative revision will, of course, be required for

any eradication scheme but the full implementation of such a scheme will take time and clear legislation is required for the immediate use of health departments and the veterinary profession.

(b) *Notification of human and animal disease*

England and Wales and Scotland are now almost the only remaining countries in Europe in which brucellosis is not notifiable (see Table). It has been notifiable in Northern Ireland and in Eire since 1949, and Northern Ireland has its own eradication pilot scheme in operation.

EUROPEAN COUNTRIES WHERE BRUCELLOSIS IS A NOTIFIABLE DISEASE

Federal Republic of Germany	Malta
Democratic Republic of Germany	Norway
Austria	Netherlands
Belgium	Poland
Bulgaria	Portugal
Denmark	Northern Ireland
Faroe Islands	Sweden
France	Switzerland
Eire	Czechoslavakia
Italy	Yugoslavia
Luxembourg	Spain

The objectors to notification take the view that it does not necessarily give a complete picture of the disease nor does it increase recognition. These points are true but there are more important values to notification. If all the known clinical cases in the Oxford area had been reported to the appropriate public health department and action had been taken, a great deal of useful work would have been achieved in clearing up infected herds, and indeed it is probable that many of the later cases would not have occurred at all. There is also the question of emphasising, by introducing notification, the importance of control of the particular disease, in the eyes of general practitioners, hospital physicians and public health departments. Clearly no one is going to consider a non-notifiable disease of much importance, since no one cares whether its occurrence is known or not.

One of the primary values of notification does, therefore, exist in the case of brucellosis, namely, that further cases can be prevented by notification and the action it is possible to take thereafter. Similar considerations apply to the notification of the disease in animals.

Liaison between Veterinary, Public Health and other Departments

Information passing to and from the various bodies concerned with brucellosis is one of the primary requirements for control of the disease and has been referred to previously (Bothwell, 1960a).

Briefly, there are advantages in setting up technical working groups in brucellosis, and this was done by the personnel in the Oxford area. The recommendations of the group have been taken some note of, and it constituted, therefore, more than "another useless committee."

Finally, something should be done about the education of the public in regard to the difference between T.T. and pasteurised milk, since a very high percentage of people believe that T.T. milk is heat treated. In a recent sample of housewives in Bristol, for example, many were quite unaware of the important difference between T.T. and pasteurised milk.

Acknowledgments.—I am indebted to the following Departments, who kindly supplied the data on brucellosis quoted in this paper: the Ministry of Pensions and National Insurance; the General Register Office; the Public Health Laboratory Service; Department of Health for Scotland; Scottish Registrar-General's Office; Northern Ireland Ministries of Health and Agriculture; Eire Department of Health. My thanks are due to Dr. A. McDiarmid for kindly reading through this paper and for his advice on the content. To Professor R. C. Wofinden I am grateful for the opportunity and permission to publish this paper.

References

BARRETT, G. M., & RICKARDS, A. G. (1953). *Quart. J. M.* **22.** 85, 23.
BEATTIE, C. P. (1938). *J. Hyg. Camb.* **38.** 260.
———, SMITH, J., & TULLOCH, W. J. (1935). *Lancet.* **1.** 1,427.
BIGGER, J. W. (1931). *Irish J. Med. Sci.* 6th series. No. 61. 150.
BOSWORTH, T. J. (1937). *J. comp. Path.* **50.** 345.
———. (1939). *Ibid.* **52.** 42.
BOTHWELL, P. W. (1960a). *Medical Officer.* **103.** 7, 85.
———. (1960b). *Vet. Rec.* **72.** 425.
BRANWOOD, A. W. (1952). *Edin. Med. J.* **59.** 591.
BRAUDE, A. I. (1955). *G.P.* **11.** 3.
BRINLEY-MORGAN, W. J. (1960). Personal communication.
CRUICKSHANK, J. C., & STEVENSON, G. A. (1942). *Brit. med. J.* **1.** 522.
DALRYMPLE-CHAMPNEYS, W. (1929). "Undulant Fever." Ministry of Health Report No. 6. H.M.S.O., London.
———. (1934). *Lancet.* **1.** 95.
———. (1935). *Ibid.* **2.** 1,449.
———. (1950). *Ibid.* **1.** 429.
———. (1958). *Vet. Rec.* **65.** 99.
———. (1960a). "Brucella Infection and Undulant Fever in Man." O.U.P., London.
———. (1960b). Presidential Address, Royal Society for Promotion of Health Congress, April.
DAVIES, J. E. (1957). *Brit. med. J.* **1.** 1,082.
ELKINGTON, G. W., WILSON, G. S., TAYLOR, J., & FULTON, F. (1940). *Ibid.* **1.** 477.
EMPSON, J. (1957). *J. Agric. Econ.* **12.** No. 3. 349.
GANADO, W., & BANNISTER, W. (1960). *Ibid.* **1.** 601.
GRANT, G. H., & STOTE, C. L. (1953). *Ibid.* **1.** 914.
HARRIS, H. J. (1950). "Brucellosis, Clinical and Subclinical." 2nd ed. New York.
HART, F. D., MORGAN, A., & LACEY, B. (1951). *Brit. med. J.* **1.** 1,048.
HUDDLESON, I. F. (1947). "Brucellosis in Man and Animals." New York.
KERR, W. R., PEARSON, J. K. L., & RANKIN, J. E. F. (1958). *Vet. Rec.* **70.** 503.
LEYS, D. G. (1943). *Brit. med. J.* **1.** 187.
LOEFFLER, W., MORONI, D. H., & FREI, W. (1955). "Die Brucellose Als Anthropo-Zoonose." Berlin.
MCDIARMID, A. (1951). *Vet. Rec.* **63.** 469.
———. (1957). *Ibid.* **69.** 877.
———. (1960a). *Ibid.* **72.** 423.
———. (1960b). Personal communication.
———. (1960c). Personal communication.
MACKIE, J. J. (1933). *Edin. Med. J.* **25.** 8. 137.
MAGOFFIN, R. L., KABLER, P., SPINK, W. W., & FLEMING, D. (1949). *Pub. Health Rep.* **64.** 1,021.
MENTON, J. (1937). *Brit. med. J.* **2.** 1,273.
———. (1940). *Medical Officer.* January 27th. P. 33.
MONTGOMERY, A. K. (1939). *Glasgow Med. J.* **13.** 4.

National Milk Publicity Council (1958). "How Housewives Buy Milk." Report of a Survey.
Northern Ireland Milk Regulations (1959). S. R. & O. of Northern Ireland, No. 68.
O'CALLAGHAN, W. P. (1931). *Irish J. Med. Science.* 6th series. **71.** 663.
———. (1932). *J. State Med.* **40.** 659.
———. (1937). *Irish J. Med. Science.* 6th series. **139.** 285.
O'DOHERTY, R. (1959). *J. Irish Med. Ass.* **44.** 263, 134.
PATERSON, D. H., & HARDWICK, C. (1938). *Arch. Dis. Childhood.* **13.** 65.
Report (1956). *Mon. Bull. Minist. Hlth. Lab. Serv.* **15.** 85.
SMITH, J. (1932). *Jour. Hyg.* **33.** 354.
———. (1951). *Hlth. Bull. (Edin.).* **9** (4). 57.
SPINK, W. W. (1956). "The Nature of Brucellosis." Univ. Minnesota Press.
STABLEFORTH, A. W. (1960). Personal communication.
STRAUSS, E. (1960). *J. Roy. Stat. Soc.* **123.** 140.
WALLIS, H. R. E. (1957). *Brit. med. J.* **1.** 617.
———. (1959). "Brucellosis in England." O'Connor, London.
WHITE, E. G. (1960). Personal communication.
W.H.O. Epidemiological and Vital Statistics Report (1959). **12.** 5-6, 110.
WILLIAMS, T. P., ENTWISTLE, D. M., MASTERS, P. L., & WOODS, A. C. (1957). *Lancet.* **2.** 1,203.
WILSON, G. S. (1932). *Vet. Rec.* **12.** 1,240.
———. (1960). Personal communication.

THE SPEAKERS' INTRODUCTION

The Chairman, Mr. J. B. White, said that the Organising Committee were to be very much congratulated on choosing such a topical subject for the Congress's opening scientific session. It was a declared policy of the Association to seek an eradication programme for *Brucella,* and that policy had the active support of the National Farmers' Union as well as that of the National Cattle Breeders' Association. They knew, also, that the staff of the Ministry were only too keen to go ahead with that as soon as the attestation programme would allow. The only people who still had to be convinced were the Treasury, and it was hoped that the speakers that afternoon, particularly Dr. Bothwell, would help convince the Treasury of the necessity for a programme.

It was unnecessary to emphasise the utter devastation that a *Brucella* storm in a herd created, and those who had had contact with persons suffering from undulant fever knew how distressing a condition it could be. So there were good reasons for trying to eradicate the disease from the country. In that respect Great Britain was lagging behind a good many countries in Europe. The Scandinavian countries and the Netherlands had made great strides towards achieving eradication.

In undertaking a programme one must have a reasonable plan of action laid out. The papers they were about to consider, all of which aimed at plans of eradication, would emphasise the steps that could be taken at the present stage to ensure that soon an overall programme would run smoothly. Dr. McDiarmid was well known to many of them and had been working at Compton for many years on brucellosis. They would later be hearing from Dr. Kerr of Stormont. Dr. Kerr had had a great deal to do with brucellosis in Northern Ireland, a country in the throes of an eradication project. Dr. Van Waveren would be addressing them and would be able to tell of what had already been accomplished in the Netherlands. He was from the State Institute in Rotterdam. Dr. Bothwell, a lecturer on public health in Bristol University, was particularly interested in epidemiology, and would be dealing with the subject from the human angle.

The Chairman then called upon Dr. McDiarmid to present his paper.

Dr. A. McDiarmid said that some years had passed since brucellosis was discussed at the annual Congress, and he was most grateful for the opportunity to present the first paper in the symposium. He had been asked to deal with the prophylaxis of the disease. That was a very comprehensive term and the paper ranged over many aspects of the problem. The paper was based mainly on questions put by practitioners, both medical and veterinary, during the last few years and each section concerned one or more of those questions.

The first section was headed "Detection and Disposal of Infected Animals." It concerned the very important question, "What was the risk of maintaining a N.V. herd in Britain at the present time?" Many such herds existed, and he believed the risk to be considerable. In the paper were set out experiences at Compton where it was necessary, for experimental purposes, to keep 3 such herds. In the last 20 years three outbreaks of brucellosis had been experienced, one in each herd, and each had been brought about through factors which could not be controlled. They were self-contained herds; and on an ordinary commercial farm each of the outbreaks would have caused serious economic loss.

There was no doubt that the incidence of the disease was still too high to warrant stopping vaccination, and yet many farmers were not so particular about their vaccination programme as they used to be.

A question which was frequently asked nowadays was concerned with the degree of immunity conferred by S.19. Under experimental conditions he expected about 80 per cent. protection against a light but effective challenge dose. If that dose was increased tenfold, perhaps only 50 per cent. of the cattle would be protected. That seemed to emphasise the danger of vaccinating stock and then doing nothing further to reduce the amount of infection on the farm.

The duration of immunity was naturally of great importance, and experiments both here and in the United States of America had shown quite clearly that calfhood vaccination with S.19 protected until at least the fifth pregnancy and probably much longer. Experiments at Compton had also shown that, although multiple vaccination appeared to be slightly better than a single vaccination, the difference was not significant. The slight benefit associated with multiple vaccination was, however, completely offset by the persisting titres which restricted the value of the blood test for detecting infected animals.

The question of adult vaccination was of considerable interest in that more and more people were now considering freeing their herds from brucellosis rather than merely controlling the clinical signs of the disease. There was no doubt that adult vaccination with S.19 carried out after the ninth month of age should be discouraged. There was no additional benefit from it and it resulted in persisting titres which would be very confusing in any future eradication scheme. It was prudent, therefore, to restrict vaccination to the sixth, seventh and eighth months of age.

Adult vaccination was, of course, still justified in a recently infected non-vaccinated herd. A system of marking vaccinated calves would be of great value in diminishing the demand for adult vaccination. Many adult cattle were vaccinated simply because their previous history was unknown. They all knew that vaccination alone would not render a herd free from brucellosis. It was important to consider the infective status of the herd with a view to eliminating any known infected animals at the earliest possible opportunity. There was always the risk of spread of infection even in a vaccinated herd; there was good evidence of that experimentally and also in the field, and the danger of mammary gland infection with virulent field strains in an immunised herd should never be overlooked. The risk of buying infected cows in the open market was very great and it should be stressed that non-pregnant young stock were always a much better proposition.

As regards breakdowns in immunity, many were due to the progressive build-up of infection in the herd without obvious clinical signs. Eventually a level was reached at which S.19 would not protect. Often one found that certain calves had been missed and only a proportion of the herd was vaccinated. It was a sobering thought that probably less than half the heifer calves in Britain were being immunised in any one year at present.

As an alternative to S.19 for adult vaccination the possibility of producing a killed non-agglutinogenic adjuvant vaccine from 45/20 had been investigated. So far the results were promising: the vaccine had given good immunity in

small experimental animals and initial trials in cattle indicated it was a good antigen. The only drawback was that the adjuvant used in the earlier experiments provoked a rather severe reaction at the site of inoculation. A different type of adjuvant was now being used which had proved to be acceptable to cattle and vaccines prepared with it had been shown to be effective in small animals. Trials in cattle were progressing at the moment. It was too early to say if this new vaccine would find a place in the prophylaxis of brucellosis; but a killed vaccine which produced immunity without the production of agglutinins would have much to recommend it.

When considering means of controlling, or eradicating, a disease it was desirable to measure the extent of the problem to be tackled. Little was known about the herd or individual incidence of *Brucella* infection, but in recent surveys in Oxfordshire and the Isle of Wight it had been found that the incidence was not so high as had been expected. Figures varied in different parts of the country, but, generally speaking, apart from some bad spots where flying herds predominated, the situation had improved compared with what it used to be. By use of the Oxford figures an attempt had been made to indicate the probable loss due to the disease at the present time. £16 million seemed a lot of money and yet beef herds with their additional losses in the export trade had not even been considered; nor the human problem, which might be much greater than many people realised.

To sum up, extension of calfhood vaccination to make it as complete as possible would do much to reduce still further the amount of brucellosis. Marking of vaccinated calves would help considerably in reducing the need for adult vaccination. Calfhood vaccination should be restricted to the sixth, seventh or eighth months because, first, immunity at the fifth was not significantly lower than at the first pregnancy; secondly, re-vaccination with S.19 did not enhance the basic immunity sufficiently to warrant its adoption in practice; thirdly, if ever an eradication scheme were introduced, late vaccination would complicate the programme; fourthly, if adult cattle were known to be infected it was good practice to eliminate them to diminish the risk of vaccination breaks.

Finally, experiments were in progress to determine if a killed adjuvant vaccine prepared from 45/20 (McEwan) could produce as good an immunity as S.19. So far, results were promising.

The Chairman then called upon Dr. Kerr to present his paper.

Dr. W. R. Kerr expressed thanks for the invitation to tell them something of the *Brucella* story in Northern Ireland. The Scandinavian countries had to be admired for the way they had tackled eradication of diseases. Holland in particular is to be congratulated on the efficient and expeditious manner in which she has dealt with *Brucella*. In Northern Ireland the story was, however, that of the beginning of an eradication scheme. Each country had found it necessary to approach eradication in its own way, for there was no fixed method applicable to all countries, governed by the type of animal husbandry, the densities of cattle populations, and so on. Northern Ireland had taken a middle-of-the-road course involving a combination of voluntary and compulsory measures, with a strict line on calfhood vaccination. They were happy to have started an eradication experiment, and the further they went with it the more happy they became and the more convinced they were that it was a practical proposition.

The first part of the paper was devoted to methods of diagnosis. The milk test had its shortcomings, it was a good test for one basic reason: the udder was the organ of choice of the organism and it was found to be present three times more often in the udder than in the uterus. It might also live in the udder for years, whereas in the uterus it seldom remained. It was desirable also to use the vaginal mucus in our tests, but it was of value only when the uterus was involved, therefore limiting its use to infected herds.

The paper discussed the problems encountered at the present stage of the scheme. Of these late calfhood vaccination or adult vaccination was the most important. For years it was recommended, and its use was right as far as control of the disease was concerned; but in facing eradication it was a menace. S.19 was harmless in the young animal, but that was not to say it was harmless in the sexually mature animal. It was stated in the literature that children were not easily infected, but brucellosis infection rose steeply after the age of 15 years. Immediately heifers began to come into season they were much more susceptible to develop a slight chronic brucellosis from S.19 vaccination.

One was apt to forget that S.19 multiplied in the animal. Dr. Stableforth put it very aptly in his book that S.19 multiplied with marked ability if even only for a restricted period. In some adult animals the position went beyond the restricted period and a high titre remained for several years. It did not seem a likely proposition that a test could be evolved that would differentiate vaccinal from field strains. There were avirulent strains in Northern Ireland which rarely produced abortion and acted serologically very much like S.19.

The persistent titre herds in the negative groups had been blood tested since compiling the paper and it was now possible to make some further observations in regard to the progress of those animals. The earlier blood test carried out one year previously showed 813 cows (16.6 per cent.) with a titre of 1 in 20 or partial 1 in 40 and 459 cows (9.6 per cent.) with a titre 40 and over. Those percentage figures were given for the entire 100 herds which included 20 non-vaccinated herds in which no reactions of 20 or over were found.

Initially it took courage to group some of the herds containing large numbers of persistent titre cows in the negative category. As an example of that type of herd, the history of one of these herds was that 28 positive titres were found which included 1 at 1,280, 8 at 640 and 5 at 320. There was the basic evidence that the adult members of the herd had been vaccinated 4 months previously; that the adjunct tests, milk and mucus, were negative; and that the herd had an abortion-free history. On that collective evidence the herd was tentatively placed in the negative group. Subsequent milk tests remained negative. At the recent blood test only 4 cows showed a titre of 1 in 40 and none in excess of that titre.

In fact, only one herd of that group failed our initial negative diagnosis. It was a herd heavily adult vaccinated with high-titre cows. On subsequent tests two cows were found to be excreting *Brucella* in the milk, one with a G type field strain and the other with characters similar to that of S.19.

The history of the cows with titres of 1 in 40 and over examined a year later in the light of the recent tests was interesting; 170 showed a definite drop in titre; 100 showed no change. In that no-change group the critical titre was apparently 1 in 40; 83 per cent. remained constant at that level. In our experience, vaccinal titres fall rapidly or slowly according to the response of the animal concerned, but there is a tendency in most to halt the fall of titre at 1 in 40 and to remain constant at that level for a long time. Twenty-three cows during the period showed a rise in titre, mostly of one dilution only. In some cows fluctuations from 40 to 160 and back again to 40 or lower had been recorded. That phenomenon apparently constitutes a phase in the progress of the vaccinal titre in certain animals.

There was one further point in connexion with the future of the 25 herds with vaccinal titres of 40 and over. To qualify for entrance to the Register they must comply with the regulations and show one clear test. At the present stage only 56 animals with titres were involved in the 25 herds, so that their removal should not constitute a serious difficulty in their disposal, or loss to the farmers concerned.

There was a low abortion rate in Northern Ireland. Table 1 in the paper was confirmation of that. One herd had 19 out of 20 infected cows excreting the infection in the milk but the organism was only present in the uterus of one and no acts of abortion were recorded. Again there was no infertility in any of the infected herds under consideration, so it could not be suggested that infertility was a factor in Northern Ireland following an abortus infection or vaccinations with S.19.

As to prozoning a question I have been asked to reply to, the abortus antigen excites several antibodies, of which

one is a blocking antibody to the agglutinin. Some excellent work had been done in America in this connexion. In the test tubes 10, 20 and 40 may be negative, but the following tubes might show positive agglutinations. There is, therefore, a blocking antibody preventing agglutination in the earlier tubes of sera from these particular animals.

The last sentence of the Statutory Brucellosis Order is interesting. It says that the Order was intended to assist cattle owners to improve the health and value of their stock, and that the object could be accomplished only with the fullest co-operation on their part.

The Chairman said it was a pleasure to welcome Dr. Van Waveren from Holland. They always welcomed a speaker from that country and they had a very high regard for the way in which Holland had tackled the *Brucella* problem.

Dr. Van Waveren said that, in the capacity of representative of the Dutch Veterinary Medical Association, he would begin by offering hearty greetings and most sincere wishes for the success of the Congress from his colleagues in the Netherlands. The President of his Association, Dr. Karsemeyer, had asked him to convey to Mr. Hignett good wishes and the assurance that he had the most agreeable memory of Mr. Hignett's visit to Holland earlier in the summer.

It was a great honour to be invited to place a paper before the Congress but it gave one the feeling of carrying owls to Athens. One could point to the basic work in the field which had been done at Weybridge, Compton and other places, for example the standardisation of the agglutination test on brucellosis and the large experiments with S.19 vaccine. Beside the British scientific contribution the workers in the Netherlands took notice of the experience regarding the control of brucellosis gained in the United States of America, in Canada and in Denmark, reported in an excellent way by Dr. Mingle, Dr. Mitchell and Dr. Nielsen at the B.V.A. Congress in 1955.

The paper emphasised that the organisation of the control of brucellosis in the Netherlands was a question for the farmers, guided by their Industrial Board of Agriculture, a public body, established by Order in Council, which was competent to promulgate decrees and to impose levies after approval by the Minister of Agriculture.

It was evident that the members of the profession officiated as the brains of the macro-organism. In the initial period the participation of the cattle farmers was free and the aim was to get experience in combating the disease while working with people who were convinced of the importance of its control and therefore willing to obey the regulations. In that period it proved to be desirable to introduce abortus ring test certificates for herds that had passed three quarterly milk ring tests, besides the "Abortus free" certification which was confirmed by a blood herd test. The more simple certificate had worked reasonably well to fill the requirements for healthy animals.

Since 1957 national regulations made by the Board had been in force and they contained some definitions and the conditions of certification. They were later on supplemented by directions on techniques and materials and the reading of laboratory tests. Levies on infected herds, decrees on hygienic measures and, recently, the prohibition of keeping reactors in some provinces had more or less brought the voluntary aspect of the activities, or the inactivities of the indolent farmers, to an end. It was now certain that the financial pains of speeding up the eradication of infected and re-infected animals in the final period would be undertaken by all cattle farmers together so that a very acceptable indemnity would be paid to those who were in trouble.

In the paper the application of S.19 vaccine was mentioned only briefly. From the results obtained from several laboratory experiments it could be said that vaccination with S.19 gave a significant resistance of a relative type. As could be expected, in the field the occasionally occurring deceptions of immunisation made more impression on practising veterinarians and farmers than did the profits.

Nevertheless, it could be stated that during several years until 1957 an extensive vaccination was carried out, certainly involving more than 70 per cent. of the calves kept for rearing, with an absolute tendency to restrict the age of inoculation between 6 and 9 months. Afterwards the impression was gained that extensive vaccination had favourably affected the situation. Last spring the importance of vaccination demonstrated itself more clearly. As a consequence of the one-sided management of veterinary practitioners and farmers, who were confronted with the difficulties of vaccination titres in heifers intended for exportation, the treatment of young stock was suspended on many breeding farms.

The drawback of that policy had now manifested itself, as the two or three fully unprotected generations of cattle in the areas which were not totally clean more often fell victims to infection, with catastrophic results. That experience had recently led to higher appreciation of S.19 vaccination as a valuable method to protect clean herds against a moderate infection and to limit the excretion of *Brucella* by infected cows. At the moment the experts were of the opinion that it would have been a wise policy to maintain the vaccination at least on and around infected farms, if necessary under compulsion.

The profit that could be gained from the complement fixation test as a supplement to the agglutination test, in relation to vaccination, normal and heterologous antibodies and to chronic infections, tempted Dr. Van Waveren to say some words about that test. As an objection against an extensive application of the complement fixation test its rather complicated execution might be cited. That difficulty could be solved by, first, substitution of the glass tubes by plastic plates with numerous boreholes with a capacity of about 2 ml.; secondly, by providing the laboratories with standardised materials (antigen complement, amboceptor and some check-sera of different titres; and, thirdly, prescribing the use of a sheepblood-suspension standardised on a certain haemoglobin percentage, in order to avoid the daily complement-titration. With the simplified method one laboratory assistant could daily test 400 blood samples.

The new techniques have been tested on a large scale in 1957. In healthy cattle vaccinated before the age of 9 months the C.F.T. became negative rather soon (after 2 to 6 months) whereas the agglutination titre persisted mostly double this time. In 10 to 20 per cent. of the older cattle in infected herds the situation was met, that the agglutination had vanished and the C.F.T. was still positive, so being a means in detecting chronic infections. Two years ago the simplified complement fixation test was officially introduced as a routine test for brucellosis besides the plate and tube test—and, it might be said, with great satisfaction. The search for improvement of diagnosis reminded one of the British comparative test with P.P.D. tuberculins, an extraordinary achievement for which Dutch veterinarians and farmers were most indebted to British scientific workers.

The Chairman, in introducing Dr. Bothwell, said that it was surprising to see the great variety of lesions and diseases caused by *Brucella* in man and the subject merited much further consideration from both the veterinary and the medical professions.

Dr. Bothwell said that he very much appreciated the privilege of presenting a paper at the Congress. It was a little alarming to hear what the Chairman had said earlier about extracting money from the Treasury and if he helped in that objective it would be the first time he had succeeded in extracting money from that source. The work which he had done on brucellosis had been carried out in conjunction with veterinarians at Compton and he was grateful for their co-operation and considerable straightforward tuition in brucellosis.

The incidence of brucellosis in the human in Great Britain was not known exactly. Information was available about the 90 or so cases which were diagnosed through and passed to the Public Health Laboratory Service every year. But for long it had been recognised that that number might be multiplied by a factor anywhere from 3 to 10 in order to obtain the real incidence for England, Wales and Scotland. The Irish (in both Northern Ireland and Eire) were somewhat more advanced in that the disease had been notifiable there for some years, so at least the number of cases officially notified was known. There, as elsewhere, it was considered that notifications were an under-estimate of the real incidence.

There were two distinct but interrelated sides of the problem, human and animal. There were many avenues along which the disease could be investigated and an attempt had been made to follow most lines of investigation in the Oxford study. Having made an estimate of the incidence of both clinical and subclinical disease in these ways, one had of course to determine whether or not the infection was important to the human subject. In public health there was a tendency to consider a disease as important if it produced a large number of cases and caused many deaths. Therefore the question was asked, "Why are you so worried about brucellosis? It is quite unimportant compared to many other conditions." That was true if one compared it with, *e.g.*, cancer and cardiovascular disease. But at what stage should a problem be dealt with? Here (in brucellosis) was a concise problem about which preventive knowledge had already been gained. There was no need to do further research to prevent the disease and this situation had existed for a long time.

It would seem that the point had been reached when it was quite practicable to check the disease in animals and therefore in human subjects. Tables in his paper had been drawn up to show the severity of the infection in recent cases, some of which had been fatal; the causes of death were in accordance with those previously described in this and other countries. The position concerning cardiovascular conditions was noteworthy, and suggested that the *Brucella* organism might find a use experimentally in cardiovascular research.

The disease tended to be rural and was a male rather than a female condition, reflecting the occupational hazard to men. In Great Britain milk was the predominant source of infection; but in the U.S.A. 75 per cent. of cases were occupationally connected with cattle and therefore might be as reasonably attributed to contact with animal secretions as to milk infection. With 94 per cent. pasteurisation one would have thought that the disease in human subjects would have disappeared from this country, but there was no evidence that recognised cases were diminishing.

The map reproduced in the paper indicated that although to some extent human brucellosis was sporadic, it was inclined to occur in particular areas. The map showed groups of cases around Wantage, and there were similar groups at Banbury, Faringdon and Newbury. This would seem to indicate that infection in the herds in these areas was endemic. A clinical human case came to the surface now and then but there would undoubtedly be a number of cases (subclinical and unrecognised clinical) in the background which were not diagnosed. The known cases were the tip of the iceberg of infection in brucellosis. As to the concentration of cases around Oxford, it should be realised that the milk consumed there came from many areas and no localisation of infected herds could be deduced from the group of cases around Oxford. The concentration of cases in the rural areas indicated the need for specific investigation there.

Notification of the human disease was another matter of importance, and if appropriate action were taken on notification the clearance of the disease would be greatly helped through routine measures. Its final elimination appeared to be in the hands of the veterinary profession and the Ministries. The cost of eradicating the disease in human cases was exactly equal to that of eradicating the disease in animals. The survey problems that would have to be solved prior to eradication would involve co-operation between the public health departments, the veterinary profession and the medical profession.

The General Discussion

Mr. P. G. Hignett (Glasgow) expressed his pleasure in listening to the 4 authors and referred to the paper by Dr. McDiarmid which spoke of 3 occasions on which *Brucella* infection was introduced into previously clean herds. In one case heifers from an infected herd went into a field with the experimental animals for a few hours in the night. Could they be told more about those heifers? Were they virgin non-lactating heifers. If they were, the fact that they could infect cows after contact of only a few hours was particularly alarming. One thought that the dangerous material for the spread of infection was the products of the uterus or mammary gland, and it was worrying to think that infection could have spread if neither of those organs was secreting.

In a herd from which the Glasgow workers were attempting to eradicate brucellosis some of the bulling heifers had recently shown a rise in blood titre from 1 in 40 to 1 in 160. These heifers were all vaccinated in 1959. They had negative titres before vaccination and positive titres after vaccination which subsequently fell to the level of 1 in 40. Was such a rise necessarily indicative of infection or could it be a normal fluctuation of titre? Since these heifers were neither lactating nor in calf they had been left for the meantime with the non-infected portion of the herd. In view of the experience of Dr. McDiarmid they now wondered whether this decision was wise.

Dr. McDiarmid said that the term "heifer" was often used to denote an animal up to the first calving; the animals which gained access to the farm where the experimental animals were kept had, in some cases, aborted. They came from a neighbouring farm where there had been a considerable amount of infection and they were discharging. The point Mr. Hignett raised was not so alarming as he thought. Fluctuations in titre did occur even over a period of years.

The Chairman said he believed that heifers could excrete quite a lot of infection before abortion took place.

Dr. McDiarmid said that was so; a heifer or cow could excrete infective discharges prior to abortion. It might be possible for an animal to introduce infection, say, a few days before abortion took place.

Mr. Hugh Boyd (Totnes) said that in the South West of England a colleague, Mr. H. C. B. Reed, and he had been doing some surveys concerning the milk ring test, and as that seemed to be one of the tests to be used in the national survey he wished to show one or two slides which dealt with it.

The following slides were then shown.

TABLE I

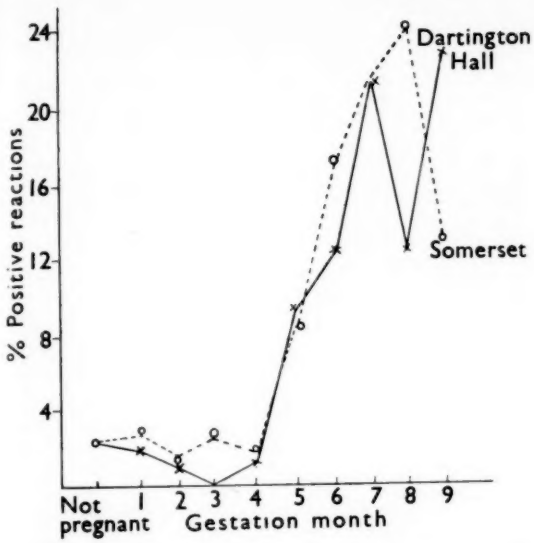
S.19 VACCINATION AND THE INCIDENCE OF POSITIVE REACTIONS WITH MILK RING TEST FOR *Brucella abortus* (DARTINGTON HALL AND SOMERSET).

Milk ring test for *Br. abortus*	S.19 vaccination				
	Calfhood	Adult	None	Unknown	Total
% positive (+ ++ +++)	3.7	10.9	2.2	5.7	4.9
Number of samples	2,201	586	534	614	3,935

TABLE II

THE INCIDENCE OF POSITIVE REACTIONS WITH THE MILK RING TEST FOR *Brucella abortus* RELATED TO STAGE OF GESTATION, S.19 VACCINATION AND INFECTION (SOMERSET).

Classification of infection	S.19	Not over 4 mths. gestation % positive	Over 4 mths. gestation % positive
Br. abortus infected herds (194 samples)	Calfhood	6.3	25.0
	Adult	15.2	26.3
	None	22.2	20.0
	Unknown	13.8	28.6
	Total	12.4	25.8
Non-infected herds (2,108 samples)	Calfhood	1.2	12.3
	Adult	4.3	24.0
	Unknown	3.2	14.3
	Total	1.7	13.1



The Chairman said that the slides were self-explanatory and they probably agreed with the experience gathered in Northern Ireland.

Mr. E. R. Callender (Lytham) said that his words were directed mainly to Dr. Kerr, but that did not mean that a tribute should not be paid to all 4 authors, each of whom had dealt in a most able manner with his own particular aspect of the very complicated problem. The first paragraph of Dr.Kerr's paper referred to milk regulations. What type of herd was involved? Did they apply to all herds providing raw milk? As to the tests that were applied, was it a case of "One positive, out!"?

Table I was of interest. Apparently only 7 out of 32 herd owners were aware of any abortus problem in their herds.

On p. 5 it was stated that

"If the test is considered free of reactors, the subsequent tests in the herd are confined to screening the herd at 3-monthly intervals."

Would the screening tests continue indefinitely after a herd was clean?

The paper contained no mention of militensis. Was there no such organism in Northern Ireland? It apparently existed in Great Britain, though he had never encountered human involvement where it was recorded in the milk. For that reason it was difficult to believe it was the same organism that occurred in Malta.

Dr. Kerr replied that it was hoped that by the end of the year all herds in Ulster would be attested. As to the *Brucella* tests, apart from the blood test the milk and the mucus were depended on, particularly in infected and vaccinated herds, and in reading the tests one developed by experience one's own criteria. It was necessary for milk screening to go on, as long as there was *Brucella* infection in the country the risk of a breakdown was always present. As to why there were only 7 herds out of 32 with definite abortions it should be noted that many of the infections were avirulent in Northern Ireland. Practitioners in Northern Ireland would say that they rarely saw an abortion storm. Some would even say they had not seen one for years.

The scheme in Ireland was a combination of the compulsory and the voluntary. All herds that supplied Grade A raw milk were compulsorily treated and so far compensation paid for the infected animals taken out of those herds.

Dr. A. W. Stableforth (Weybridge) said that the *Br. melitensis* isolated in Great Britain was a well characterised strain indistinguishable from the classical *melitensis* except that it was lysed by a phage which lysed *Br. abortus* but not the classical *melitensis*, and seemed never to affect human beings. It seemed less pathogenic to human beings than *abortus*. Dr. McDiarmid gave in his paper an estimate of £16 million annual loss. If the figure were a true one they ought to take a lot of notice of it, but they must be careful lest they used a figure which could not be substantiated and it would be useful if they could have a little more information of its basis. The paper referred also to strain 19 as localising in the pregnant cow. Did that relate to new experience or to what was in the literature? Did it relate to subcutaneous vaccination?

Dr. Bothwell had drawn attention to the position in Oxford; did the milk come from all over the place or from one or more particular area?

Would Dr. Van Waveren say a little more about the complement-fixation test for distinguishing infected and vaccinated animals? Was the difference between it and the agglutination test qualitative or quantitative? Could he also comment on the value of the Coombs test which in Germany had been reported useful for detecting animals with blocked or incomplete antibodies?

Dr. McDiarmid said that his observation about localisation of S.19 in a pregnant animal was based on experience at Compton. Pregnant animals had been vaccinated with S.19 and on rare occasions—the incidence was perhaps 1 to 2 per cent. —localisation did take place in the genital tract. It was the kind of situation that might well arise in a newly infected herd where there had not been any previous vaccinations and where the veterinary surgeon vaccinated all the animals irrespective of whether or not they were in-calf. That would be a perfectly justifiable procedure. He personally had never recovered S.19 from the milk of lactating cattle that had been vaccinated subcutaneously by the usual route. To do so must be extremely rare.

On the economics of the subject, an animal known to be infected with *Brucella* was certainly worth a lot less than an animal not infected. An auctioneer friend had estimated that this depreciation might be about £25. It seemed to be agreed that 70 dollars was the amount lost per infected animal in the U.S.A. On such a basis the figure of £16 million was justified. Some additional figures relating to the U.S.A. had just come to hand and they stated that, whereas 10 years ago the loss due to brucellosis was about the 100 million dollar mark, in the present year the loss was down to about 25 million dollars. On the human side, the number of human cases about 10 years ago was 10,000, the cost being about 30 million dollars, and in the present year there were about 1,000 diagnosed cases and the cost was about 3 million dollars.

Dr. Van Waveren said that the Coombs test was not fit for use as routine test because it is too complicated and laborious. When this test produced an absolute negative reaction in bovine serum it was a confirmation of freedom of infection.

In several thousands of blood samples originating from "problem animals" the Coombs test proved to be positive in ± 15 per cent. of the cases in which the agglutination test was negative or slightly doubtful, the first test being able to detect incomplete antibodies resulting from *Brucella* infections.

This property makes the Coombs test very suitable as an additional test to the agglutination test in milkwhey, as incomplete antibodies are often met within the whey.

Dr. Stableforth asked what was meant by the phrase "from the health service."

Dr. Van Waveren said he meant the Netherlands animal health service.

Mr. O'Sullivan (Milk Marketing Board) asked whether the authors had had any experience with agglutinin tests or possibly complement fixation tests with bull semen. His organisation would deal with a small number of bulls that might be doubtful on blood test; samples of semen would be sent for testing, and the results would vary a great deal. The M.M.B. were naturally interested in the subject of brucellosis. It was responsible for selling milk and milk products and in the past had carried out surveys into the incidence of brucellosis and the application of vaccination and a lot of the material had been published.

In 1959 it carried out a survey into milk samples in Dorset.

Dr. Bothwell said that, in reply to Dr. Stableforth, his point about Oxford was that the series of cases there did not relate to a specific milk source. There had been no other cases in Oxford city since 1953 and it appeared to be the general trend in large cities to have few cases occurring. Mention had been made (by Dr. Kerr) of excretion of field strains of *Br. abortus* in milk, in spite of S.19 vaccination, and this seemed to him a particularly important point in relation to human infection which might to some extent explain part of the persistence of human disease.

Mr. W. Tweed (Chester) wanted to add his praise to the authors and said he regarded the subject and the session as important. There was much interest in the subject since the announcement of the Ministry's survey scheme, many more farmers than they could offer the service to were wanting to take advantage of it. What was needed at the moment was advice on how to proceed where the medical officer of health reported milk containing infection. The veterinary practitioner and the Ministry's field officer were left holding the baby. He was pleased to see Dr. Ross present as a representative of the Ministry of Health, because medical officers were to-day becoming more and more interested in the *Brucella* problem and reporting more positive samples.

Dr. Kerr said that a cow might carry infection in the udder for 2 or 3 years. Where a bulk sample of milk was positive and the individual cows responsible were found, was it advisable to recommend that the cows should suckle calves or should the farmer be advised to dry the cows off? What were the chances of them calving down free of infection at the next lactation? A notice from the medical officer of health would probably have been served asking the owner to pasteurise the whole of his milk, or Section 31 of the Food and Drugs Act might also be evoked to prevent the sale of the milk from the individual cows altogether.

Veterinary practitioners wanted to know how to help the farmer who was not yet in a position to receive compensation for the slaughter of infected cows. It was advisable to inform a farmer that adult vaccination would interfere with eradication, but when a farmer was threatened with an abortion storm he wanted adult vaccination. The farming community required education concerning eradication of the disease. There could be no better way than an eradication scheme by which the farmer and the veterinary surgeon tried to get as far as possible in a voluntary way.

Dr. Kerr said that there were some people who had recorded udder infection for 5 or 6 years. In our case we had followed positive cows for 3 years. It could be intermittent or constant in excretion of organisms. The infection could be spread by hand, by the milking machine or by food contaminated by the milk.

Dr. McDiarmid said that the question of persisting udder infection was very important. An animal which was confirmed as infected by biological test should always be considered to be infected. That was the only safe way of coping with the situation. He himself would be quite prepared to drink bulk milk tested by the ring test. It was good to know that some people were still prepared to do things on a voluntary basis. Certainly there was one practitioner in the South of England who said there was no brucellosis infection in his practice with the exception of one herd, and he claimed that that situation was achieved by education of his clients. The statement was a bold one but it might be perfectly correct. All his clients had been asked to use calfhood vaccination and nothing else. A determined effort over the years had been necessary. There was no reason why the same sort of thing should not be done in other areas, but the flying herd areas were certainly difficult to cope with.

Dr. Bothwell said that he entirely agreed with the points Mr. Tweed made. There were some 5 pieces of legislation which dealt with one point or another about *Brucella* in milk. They resembled in some ways the Lords Day Observance Act, in that they went back quite a long way, and the Scottish licensing laws, in that there were innumerable ways of getting round them. There were also milk regulations which were confused a little with food and drug regulations. Those things ought to be put together and clarified so that the medical officer of health and the veterinarian and his clients knew exactly what should happen. The matter was worthy of joint meetings of the Ministry of Health and the Ministry of Agriculture. It was not beyond their ability to get together to put the regulations in some understandable form to meet current requirements.

The Chairman said that he could speak as one who had the experience of a farmer approaching him as a practitioner and saying that notification had been sent him of the presence of *Brucella* in the milk, and asking what should be done. The procedure he had adopted was to get in touch with the V.I.O. service, who said they were willing to do ring tests. The Ministry of Health locally were told of the steps being taken, and between them a fair measure of success was achieved. If people would approach the veterinary investigation centres and the Ministry of Health and get the two to work together it would do a great deal towards providing a sample that was clear or possibly clearing the herd entirely.

The meeting would wish the authors to be warmly thanked. The subject was of outstanding importance at the moment and deserved the utmost attention from the profession, and the authors deserved a hearty vote of thanks for the excellent way in which they presented their papers and answered the discussion. (Applause.)

FUTURE UNIVERSITY EXPANSION

A report on the further expansion of the universities in the 1970s, to provide places for the rapidly increasing proportion of boys and girls who are expected to stay at school to qualify for university entrance, has been prepared for Mr. Selwyn Lloyd, the Chancellor of the Exchequer, by the University Grants Committee.

In a note attached to the statistics for the academic year 1958-59, published recently, the committee state that besides attempting to provide 170,000 to 175,000 places by the mid-sixties they have asked the universities to consider what further expansion in student numbers they are prepared to contemplate by the early seventies, together with their requirements for new accommodation.

The committee did not, as in 1957, set expansion targets for each university. Their officers had 36 meetings with representatives of the universities between February and July, 1960, to discuss future student numbers and building requirements, and the report to the Chancellor of the Exchequer was prepared on the basis of these talks.

The committee considered the development of faculties or departments of Applied Sciences in the smaller and medium-sized institutions which at present have only two broad faculties—Arts and Pure Science—and which, while willing to expand their numbers, would be unable to do so on any large scale without the introduction of some form of Applied Science. They saw the same problem arising with any new university institution wishing to develop Applied Science.

The committee felt that the long-established practice whereby new institutions passed a period of years in association with the University of London, adopting its entrance requirements, using in the main its curricula, and taking its degree examinations and degrees, had served the need of the times.

R.C.V.S. Council Meeting

The quarterly meeting of the Council of the Royal College was held at 9 and 10, Red Lion Square, on September 30th. In the absence of the President through illness, Mr. G. N. Gould, senior vice-President, presided. In opening the meeting Mr. Gould said he was pleased to report that the President (Mr. J. N. Ritchie, C.B.) was now out of hospital and making good progress. He had written to express his regret at not being able to be present at the final quarterly meeting of Council in Red Lion Square, and to convey his thanks for the many messages he had received.

Members then stood in silence to the memory of members who had died since the previous meeting.

The Chairman made special mention of Mr. Edward Morgan of Venezuela, who had married a previous employee of the Royal College: Miss Blake had been on the secretarial staff of the Royal College from 1918 to 1922. She had been succeeded at the Royal College by Mr. F. Knight, who subsequently became General Secretary of the British Veterinary Association.

Under "general correspondence" it was made known that the President had been unable to attend the Royal Society's tercentenary: but the Registrar had, in company with representatives of other learned bodies, attended at the Albert Hall to present an illuminated Address on behalf of the R.C.V.S.

Mr. H. W. Dawes would retire on December 31st, 1960, as the College's representative on the Council of the Royal Veterinary College and was available for re-election. On the motion of Dr. Glover, seconded by Mr. Holroyd, he was reappointed to represent the Royal College for a further period of three years, with an expression of appreciation for his services.

The President had nominated Mr. W. J. Daniel and Mr. A. J. E. Woods to be his representatives at the annual meetings of the British Association held from August 31st to September 7th.

Reports of Committees

Examination and Education Committee

This report having been presented by Professor H. Lamont, Dr. W. Wooldridge said that in two or three items reference was made to Heads of Schools making recommendations and observations, and there figured in their curricula a list of meetings to be held. He asked what was the position of the Heads of Schools as a body in relation to the Royal College. He thought it would be a pity if the impression got around that the Heads of Schools were endeavouring to run the Examination and Education Committee. He did not think they were, but in future it might be better to refer to whichever Head of a School made a particular observation instead of a general reference to Heads of Schools as a body.

Dr. Wooldridge was referring, presumably, to two items in the minutes, respectively the new regulations for the FitzWygram, Williams, Walley and Lawson prizes and the proposals for a new diploma of associateship in connexion with the Working Party on Veterinary Education in the Developing Countries. In both these matters, the Heads of Schools had been jointly consulted in their academic capacities.

Professor Lamont replied that some of the matters coming before his committee were very involved, and he had felt it desirable to have the Heads of Schools present as they would be involved in implementing any decisions. He had been very grateful to the Heads of Schools, who were only present for consultation and advice.

Professor Weipers said it had been the will of the last Council meeting that there should be consultation with Heads and representatives of Schools, who had no rights as such within the Committee except when a particular matter was referred to them.

Dr. Wooldridge said he was happy with the statement made to Council: he had no feeling in the matter, but there was an interest in the profession generally on matters such as this, and it was valuable they should know this was not a body suddenly becoming active as a body within the Royal College.

At its meeting, which had been held on September 29th, the Examination and Education Committee had received from the Parliamentary Committee the information that the scheme for nursing auxiliaries had been discussed and that it had been agreed to refer the matter back to the Joint Committee of the R.C.V.S. and B.V.A. In the course of discussion it was made clear that the Royal College would be an examining body only and would not be concerned with teaching student auxiliaries.

With regard to the intake and output of veterinary students, it was reported that the President had set up a Committee to make a preliminary study of this matter. It was hoped as a result of the Committee's work to estimate the probable future demand for new entrants to the profession.

The Finance and General Purposes Committee

Mr. A. J. Wright presented this report. In the matter of the removal from Red Lion Square, Professor L. P. Pugh (Chairman of the Building Committee) reported that the premises had been sold for £195,000, but this figure would be reduced to about £190,000 when account had been taken of expenses for professional services of architect and quantity surveyors. They had looked for temporary accommodation on lease; but their professional advisers thought this might be difficult and recommended taking a longer lease or purchasing, with the idea of giving up the lease or selling when a permanent building was ready. They had to be out of Red Lion Square by January 9th, 1961, so the Building Sub-Committee recommended to Council that it be empowered to acquire temporary accommodation to house the College administration and Library, and to make all arrangements for the removal and storage of the College possessions according to the temporary accommodation available at the time of vacating.

The Parliamentary Committee

Professor Weipers presented this report. The Chairman reported having attended as a guest of the Minister of Agriculture, a party to celebrate the signing of The Tuberculosis (England and Wales Attested Area) Order, 1960, the effect of which was to declare England and Wales to be an attested area. (This occasion was described in THE VETERINARY RECORD of October 1st.) The Minister had asked Mr. Gould to convey a message to the profession thanking them for their great efforts.

Dr. Wooldridge wished to draw the attention of Council to meat inspection in England and Wales. In the Parliamentary Committee's report it was stated they were going to continue to confer with Sir John Maitland as to the best course to follow. He thought the matter was far more important than that, because they had got the Ministry to say something about the future of meat inspection, including inspection of the live animal, and that, in all discussions over many years with the Ministry, had always implied the use of surgeons. In fact, it had never been accepted by anyone that such inspection could be done without veterinary surgeons. He was convinced that the Ministry's statement had been worded in that way to meet the point asked for by the Royal College and the British Veterinary Association. He was most anxious that they should not now lapse into doing nothing. In the past, every 3 or 4 years, they had tackled the problem of meat inspection and had created a certain amount of nuisance. They thought they were putting forward constructive proposals, but when these were not fully met they had sat back and done nothing for another 3 or 4 years. He was convinced the profession would be able to get its rightful place in meat inspection provided they continually pressed that point of view, and provided they co-ordinated their attempts to do so.

No mention had been made of establishing conversations with the B.V.A. He felt they should decide at once on a concerted attack. Pressure should be put on the Minister from the Parliamentary angle, and Dr. Wooldridge proposed they should press this matter as widely and as constructively as possible.

Professor Weipers said it was difficult to convey to Council in a brief report all that had been said in his committee. This particular matter was one of tactics, and there had been difficulties in having a question put before the Recess in the last House of Commons. They agreed wholeheartedly with Dr. Wooldridge that this was an important matter and should be pressed, but the committee had been occupied at the time with the tactical exercise of having some statement in the House about the importance of veterinary meat inspection. This was the first step in the overall campaign. He agreed it should be done in conjunction with the B.V.A.

A further point of interest which was Minuted at a meeting of the Parliamentary Committee on September 29th was that a committee had been appointed in connexion with Fowl Pest. It had been resolved that the College should present evidence on this subject and that a report should be prepared by a small committee consisting of Professor Beveridge, Dr. Jordan, a nominee of the President and other co-opted members if required. Consultations would be held with the British Veterinary Association, but evidence would be given separately to the Government Committee which was considering the Fowl Pest problem.

News and Comment

VETERINARY SURGEONS' DAY AT BARLBY FARM, SELBY

Some 50 veterinary surgeons from all over the North and Midlands accepted an invitation from the British Oil & Cake Mills Limited, to see their work with cattle and calves at their Northern Testing Station, Barlby Farm, Selby, and to discuss problems of mutual interest.

In the Dairy Bull Progeny Test they saw 4 early weaned and standard-reared groups of animals, of which 2 are calving for the second time under test conditions, the first time this has been done anywhere in the world. In the calf house the troubles associated with bought-in calves were demonstrated by the condition of some 20 Aberdeen Angus x Friesian which had just arrived from South-west England.

Before lunch the visitors were welcomed by Mr. H. M. V. Wright, a director of the company, and afterwards a very vigorous discussion developed on what the chairman—Mr. R. B. Little, area adviser—called "vetnuts"—problems affecting both the veterinarian and the nutritionist. The discussion panel included Mr. M. W. MacLean, the local veterinary surgeon, Mr. P. I. Bichan, the station manager, Mr. W. B. V. Sinclair, the V.I.O. from Leeds, Mr. W. K. Hunter, the Regional Veterinary Officer, M.M.B. and Dr. J. H. McCoy, of the Public Health Laboratory, who is interested in animal salmonellosis affecting humans.

Bloat in calves, scour and calf diseases generally, the effect of the widespread use of antibiotics, the problem of temporary infertility where a herd is collected from a variety of sources, the problem of enlarged hocks and the peculiarities of calves which consume all the woodwork in sight, were among the subjects raised.

THE CAMBRIDGE SOCIETY FOR THE STUDY OF COMPARATIVE MEDICINE

The Society met in the Lecture Theatre of the School of Veterinary Medicine at 8.30 p.m. on February 26th, 1960. Dr. R. M. Fry was in the chair.

Dr. Fry introduced the subject of the evening, "Man as a Vector of Animal Disease." He said that this topic would involve a reversal of thought as far as many were concerned. Dr. Joan Taylor discussed the possibility of man as a source of infection in bovine mastitis. The infection was some-

times caused by the same phage type of staphylococci as those found in man. She also discussed yolksac infection in chicks caused by contamination of eggs during candling. Streptococcal infections of animals might be of human origin. It was more difficult to know whether such a host specific organism as the *Salmonellae typhi* could cause infection in animals. She discussed the example of a cow which may have been a typhoid carrier but showed no signs of infection. Other *Salmonellae* of human origin might infect chicks and wild birds which feed on sewage.

Professor Beveridge emphasised the differences in epidemic disease of farm animals and man, and said that epidemic diseases spread rapidly in human communities because of frequent movement of individuals within the population. This did not tend to be so in farm animals, though dogs and cats rather resembled man in this respect. He described infections in the dog with the human type of tubercle bacillus and in the cat with the bovine type; parrots and monkeys were not frequently infected by human type. Vaccinia was not infrequently transferred to the cow by a recently vaccinated human being; most cow pox amongst cattle in this country could be traced to human contact. Horsepox and swine pox, and foot-and-mouth disease were frequently transferred by human means.

Dr. Soulsby spoke about metazoan parasites transferred to animals from man and described in detail infections with *Taenia saginata*. This infection provided a serious problem to Kenya with at least 80 per cent. of the African population excreting the eggs of this tape worm. He discussed the ways in which man might infect cattle and the importance and significance of the fact that most infections occurred in the first 3 months of the animal's life. He emphasised the serious economic loss which these parasites produce in Kenya.

R.C.V.S. TRUST

The Council of the Royal College of Veterinary Surgeons Trust announce the following Fellowship: the Pig Industry Devolpment Authority Fellowship for research in pig health. Its value is £1,500 p.a. with an additional expenditure grant to a maximum of £1,000 p.a. Further details may be obtained from the Secretary, R.C.V.S. Trust, 9 Red Lion Square, London, W.C.1, and the closing date for applications is February 25th, 1961.

Mr. G. H. LOCKE

His many friends will learn with deep regret of the death of Mr. G. H. Locke, a doyen of the profession, which took place last Friday. It will come as an additional shock when it is realised that he was able to be present as an honoured guest at the last meeting of the R.C.V.S. Council to be held at Red Lion Square as lately as September 30th. Mr. Locke was an honorary member of the B.V.A. —a distinction rarely accorded by our Association— and a past President of the R.C.V.S. The funeral took place at Crawley last Monday, when the B.V.A. and the Royal College were both represented by Mr. J. M. Ingram.

It is hoped to publish a biographical memoir next week.

Mr. HUGH CAMERON WATSON

The death has taken place in George, Cape Province, South Africa, on September 25th of Mr. Hugh Cameron Watson.

He was born at Strathconon, Ross-shire, and received his education at the Royal High School, Edinburgh, and the Royal (Dick) Veterinary College, Edinburgh, from which he graduated M.R.C.V.S. in 1925. After gaining some experience in this country he spent many years in Asia in charge of dairy farms, first of all at Shanghai and latterly at Hong Kong, where he was interned during the whole of the Japanese war. Shortly after the war he left Hong Kong and went to George, where he built up a successful practice as a veterinary surgeon. On September 25th he died suddenly as the result of a coronary thrombosis. He is survived by his widow, one daughter and one son.

Mr. HERBERT JOHN LOWE

N.R.R. writes:—

Herbert John Lowe died at Mallow, Eire, on August 4th, 1960, at the age of 67.

Bertie, as he was known to all East Africans, was a great character. Fiery-tempered, he had nevertheless a great fund of humanity and kindliness; and no one loved a good party better than he did.

In his professional career Bertie Lowe did a lot. Coming to Tanganyika at the end of the First World War, in which he served from 1914-18 in France, he immediately became involved in the unending struggle to control rinderpest and contagious bovine pleuropneumonia. During the depression years of the thirties, he carried on the fight and it was largely due to his efforts that these diseases were finally brought under control.

Lowe was firmly convinced of the part that the veterinarian should play in developing animal husbandry as well as animal health. Becoming Director of Veterinary Services and Animal Husbandry in 1938, he established a department which was a happy combination of both, which did good work in both research and field. Moreover Lowe was one of the first to realise the importance of training Africans. He personally established the school at Mpwapwa for veterinary assistants in 1935.

For his work he was honoured with the C.B.E. in 1943. He retired in 1947 after 29 years' service in Tanganyika.

Bertie Lowe will be remembered with affection and respect by his colleagues and friends of all races.

He leaves a wife and son to whom our deepest sympathy is extended.

THE REGISTER OF VETERINARY SURGEONS

In the issue of THE VETERINARY RECORD for August 13th, 1960, page 669, the names of two gentlemen admitted to the Commonwealth List of the Register were recorded as: KHENG, Chong Sue; and NAM, Cho Chak. We are advised that their names should be recorded correctly as: CHO, Mr. Chak Nam; and CHONG, Mr. Sue Kheng.

B.O.C.M. 14th ANNUAL POULTRY TRIALS

On the evening of Tuesday, October 25th, at Grosvenor House, Mr. A. E. Robinson, the Chairman of British Oil and Cake Mills, and Dr. W. P. Blount, one of its directors, entertained representatives of the poultry and allied industries including the British Broilers Association, the British Egg Marketing Board, the British Turkey Federation, and Regional Poultry Officers. The results of the Poultry Trials were announced and awards made. Mr. Robinson, in his speech, reviewed the reasons for the rapid strides made by the poultry industry, particularly in recent years. He was followed by Dr. R. Coles, Chief Poultry Advisory Officer, Ministry of Agriculture, who after a review of the N.A.A.S. problems in relation to the industry, presented the prizes.

Dr. W. P. Blount outlined in each case the requirements of the individual championships and competitions, which numbered 30, the principal awards were:—

The Championship Cup for the Hen Battery Laying Trials: J. C. Cooper Research Farm, East Haddon, Northampton; *Scottish Hen Battery Laying Trials:* High Peacock Farm (Thornber Bros. Ltd.), Stewarton, Kilmarnock; *Five-hen Day Random Sample Hen Battery Laying Trials:* F. & G. Sykes Ltd., Biss Farm, Upton Scudamore, Warminster, Wilts.; *Special Award (Internal egg quality)—silver medal:* A. S. Vellacott, East Clayton Farm, Washington, Sussex; *First Broiler Breeding Trial—Championship Cup:* F. & G. Sykes Ltd., Sutton Veny, Warminster, Wilts.; *Cafeteria Hen Battery Laying Trials:* G. E. Shillito, Chaworth Poultry Farm, Annesley Woodhouse, Kirby-in-Ashfield, Notts.; and *Aylesbury Duckling Feeding Trial—£20:* Colonel H. K. Blaber, C.B.E., Farthings Duck Farm, Lodden Drive, Wargrave, Nr. Reading, Berks.

R.C.V.S. OBITUARY

We record with regret the death of the following members of the profession:—

WATSON Hugh Cameron, 10 Caledon Street, George, C.P., South Africa. Graduated July 15th, 1925, at the Royal (Dick) Veterinary College, Edinburgh. Died September 25th, 1960.

BRAIN, John Leicester, of 5 St. George's Terrace, Cheltenham. Graduated Royal (Dick) Veterinary College, July 20th, 1923; died October 21st, 1960.

PERSONAL

Dr. W. R. Wooldridge, Scientific Director of the Animal Health Trust has been re-elected Chairman of the Governors of Birkbeck College in the University of London.

Births

JONES.—On October 7th, 1960, to Margaret, wife of Colin R. V. Jones, M.R.C.V.S., of "Pook Hayes," Leigh Road, Chulmleigh, N. Devon, a son, Colin Mark, brother to Ruth, Sarah and Karen.

KLUTH.—On October 19th, 1960, at 5, Cambridge Place, Falmouth, Cornwall, to Mary (*née* Wood) wife of George Kluth, B.VET.MED., M.R.C.V.S., a daughter, Christina Anne Scott.

ROGERS.—On October 10th, 1960, to Audrey and Michael Rogers, MS.R.C.V.S., of St. Giles House, The Terrace, Cheadle, Staffs., a daughter, Sarah Louise, sister for Helen.

STRANG.—On October 22nd, 1960, to Anne (*née* Walker) and Robert D. Strang, M.R.C.V.S., at 18 Wortley Road, Highcliff-on-Sea, Christchurch, a son, Richard, brother for Susan and Robert.

COMING EVENTS

October

31st (Mon.). EAST YORKSHIRE CLINICAL CLUB. Meeting at the Talbot Hotel, Malton, 8 p.m.

November

2nd (Wed.). MIDLAND COUNTIES VETERINARY ASSOCIATION. Joint Meeting with the Midland Medical Society Section, at the Birmingham Medical Institute, 36 Harbourne Road, Edgbaston, Birmingham, 15, 8.30 p.m.

CAMBRIDGE SOCIETY FOR THE STUDY OF COMPARATIVE MEDICINE. Meeting in the Lecture Theatre, Department of Veterinary Medicine, Madingley Road, Cambridge, 8.30 p.m.

3rd (Thurs.). CENTRAL VETERINARY SOCIETY. Meeting at the Royal Veterinary College, Camden Town, N.W.1, 6 p.m.

4th (Fri.). A.V.T. & R.W. SOUTHERN REGION. 17th meeting at the Royal Veterinary College, Royal College Street, Camden Town, London, N.W.1, 11 a.m.

SHROPSHIRE VETERINARY CLUB. Meeting in the Oak Hotel, Shelton, Shrewsbury, 8 p.m.

9th (Wed.). EASTERN COUNTIES VETERINARY SOCIETY. Autumn Meeting at the School of Veterinary Medicine, Madingley Road, Cambridge, 11 a.m.

B.S.A.V.A. METROPOLITAN REGION. Meeting at the Royal Society of Medicine, 1 Wimpole Street, London, W.1, 7 p.m.

DUMFRIES AND GALLOWAY DIVISION. Autumn Meeting at the Queensberry Arms Hotel, Annan, 2.15 p.m.

SOUTHERN COUNTIES VETERINARY SOCIETY. Meeting at the Red Lion Hotel, Salisbury, 7.30 p.m.

10th (Thurs.). B.S.A.V.A. SUSSEX DIVISION. Meeting at the Ciba Laboratories, Horsham, 8 p.m.

11th (Fri.). V.V.B.F. NORTH OF SCOTLAND DIVISION. Annual Dinner-Dance in the Northern Hotel, Aberdeen, 7.30 p.m.

ROYAL VETERINARY COLLEGE ASSOCIATION. A.G.M. at Royal Veterinary College, Camden Town, N.W.1, 6 p.m., followed by the 23rd Commemoration Ball at the College, 8 p.m. to 2 a.m.

17th (Thurs.). DUMFRIES AND GALLOWAY V.V.B.F. LADIES GUILD. Annual Buffet Dance at the Cairndale Hotel, Dumfries, 8 p.m.

V.V.B.F. COUNTY OF AYR LADIES' GUILD. Annual Buffet Dance in Western House, Ayr.

23rd (Wed.). WESTERN COUNTIES VETERINARY ASSOCIATION. Annual Dinner Dance at the Imperial Hotel, Exeter, 7 p.m.

23rd and 24th (Wed. and Thurs.). B.V.A. CONFERENCE ON HYPOMAGNESAEMIA. Meetings at the Victoria Halls, Southampton Row, London, W.C.1, commencing 10.30 a.m. each day.

December

2nd (Fri.). NORTH OF ENGLAND VETERINARY MEDICAL ASSOCIATION. Annual Dinner-Dance at the White Swan Hotel, Alnwick.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Ayrs. East Spittal Farm, Stewarton, Kilmarnock (Oct. 18).

Sussex. Ewhurst Manor, Shermanbury, Horsham (Oct. 20).

Foot-and-Mouth Disease

Yorks. Carr Farm, Thorner, Leeds (Oct. 20); Eltoft, Thorner, Leeds (Oct. 24).

Fowl Pest

Cambs. 3, Glebe Close, Manea, March (Oct. 19); The Orchard, Watsons Lane, Little Thetford, Ely; 1, Council Houses, Little Thetford, Ely (Oct. 20); 5, Glebe Close, Manea (Oct. 23).

Dorset. East Swillets Farm, Seaborough, Beaminster (Oct. 18).

Essex. Russell House, Canvey Island (Oct. 22).

Kent. Little Oakhurst, Bethersden, Ashford (Oct. 20).

Lincs. Marina House, Boundary Lane, South Hykeham; Thorpe Lane End, South Hykeham (Oct. 20); Four Acre, Station Road, Waddington (Oct. 21); Mill Farm, North Hykeham; Roskellan, Thorpe Lane, South Hykeham; 110, Moor Lane, North Hykeham (Oct. 22); Crow Park Farm, Thorpe Lane, South Hykeham (Oct. 24).

Norfolk. The Old Rectory, Snetterton, Norwich (Oct. 19); Heath Road, Banham, Norwich; The Laurels, Grove Lane, Banham, Norwich (Oct. 20); The Mill, Banham, Norwich (Oct. 21); Rectory Dairy Farm, Banham, Norwich; Mayers Farm, Great Moulton, Norwich; Foxdene (Nr. the Church), Banham, Norwich; Heath House Farm, Banham, Norwich; The Factory, Banham, Norwich (Oct. 22); Walnut Tree Farm, Tibenham, Norwich; Mill Farm, Banham, Norwich; Rosery Farm, Banham, Norwich (Oct. 23); White House Farm, Fressingfield, Harleston; The Bakery, Banham, Norwich; Lime Lea, Banham, Norwich; Yew Tree Farm, Heath Road, Banham; Goose Green Farm, Winfarthing, Diss (Oct. 24).

Notts. Woodley Poultry Farm, Thorpe, Newark (Oct. 21).

Somerset. No. 1 Pie Corner, Merriott, Crewkerne; Lower Easthams Farm, Crewkerne (Oct. 18); Footlands Farm, Merriott, Crewkerne; 2, Merriottsford, Crewkerne; New Farm, Over Stratton, South Petherton (Oct. 19); Higher Eastmans Farm, Crewkerne; Mill Farm, Misterton, Crewkerne (Oct. 20); Mulberry Farm, West Pennard, Glastonbury (Oct. 21); Sunrays, West Pennard, Glastonbury; Bincombe Farm, Crewkerne; Mill Farm, Weston Bampfylde, Sparkford; Glenfield Farm, Haselbury Plucknett, Crewkerne (Oct. 22); Breach Farm, West Pennard, Glastonbury; 32, Lower Street, Merriott, Crewkerne; Shutteroaks, Toll House, Crewkerne; The Grange, West Pennard, Glastonbury (Oct. 23); Fern Cottage, Henley, Crewkerne; Woodland House, West Pennard, Glastonbury; New Chester Cross, Merriott, Crewkerne (Oct. 24).

Suffolk. 2, Council Houses, Wattisham, Ipswich (Oct. 19).

Swine Fever

Anglesey. Bachau Farm, Llandegfan, Menai Bridge (Oct. 19).

Berks. The Windmill, Sheepcote Lane, Bray, Maidenhead (Oct. 21).

Ches. Doddlespool Farm, Betley, Crewe (Oct. 19).

Durham. Whessoe House, Burtree Lane, Harrowgate Village, Darlington; Whessoe Grange Farm, Burtree Lane, Darlington; Abbotsford Road Allotments, West Hartlepool (Oct. 18); Brinkburn Road, Allotments, Darlington; Skerningham Farm, Harrowgate Hill, Darlington (Oct. 20).

Essex. Patch Park Farm, Abridge, Romford (Oct. 24).

Flints. Cwybr Ucha Piggeries, Rhuddlan, Rhyl (Oct. 18).

Hants. Piggeries, Eames Farm, Thorney Island, Emsworth (Oct. 19); The Bungalow, Soper's Bottom, Appleshaw, Andover (Oct. 21); Southwood Farm, Cove, Farnborough (Oct. 24).

Lancs. Crossfields, New Hall Avenue, Marton, Blackpool; Isles Field Farm, Goosnargh, Preston (Oct. 24).

Mont. Heylin, Guilsfield, Welshpool (Oct. 24).

Norfolk. Station Road, Belton, Great Yarmouth (Oct. 19).

Salop. Home Farm, Macefen, Whitchurch (Oct. 21); Upper Farm, Shotatton, Ruyton XI Towns, Shrewsbury.

Staffs. The Hawthorns, Littywood Lane, Bradley (Oct. 24).

Suffolk. Fentons Farm, Gt. Welnetham, Bury St. Edmunds (Oct. 19); Oak Cottage, The Green, Stowupland, Stowmarket (Oct. 20).

Surrey. Farleigh Court Piggeries, Farleigh Court Road, Farleigh, Warlingham (Oct. 24).

Warwicks. Ryon Hill Farm, Warwich Road, Stratford-on-Avon (Oct. 21).

Wilts. Alton Manor Figheldean, Salisbury (Oct. 20).

Worcs. Woodbury Hill Farm, Great Witley (Oct. 20); Sneachill Farm, Spetchley (Oct. 24).

Yorks. Nethercar Farm, Tockwith (Oct. 19); Knabbs Farm, Fellisciffe, Harrogate (Oct. 20); Townend Farm, Deighton, Northallerton; Greystones, Catterick, Richmond; Pasture Road Allotments, Goole (Oct. 21); Hill Farm, Sutton-on-Hull, Hull (Oct. 24).

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

Veterinary Education

SIR,—May I support Mr. Pickering's letter in your issue of October 22nd, particularly his two final paragraphs? Having myself been especially fortunate in attending College at a time when there was an absolutely first-rate teaching staff, I sympathise most strongly with those generations of students who have to suffer the ministrations of inadequate teachers who can be removed only by death or retirement. As Mr. Pickering rightly points out, we can all call to mind some teacher we consider not up to his job and there is nothing anyone can do about it.

It is, however, the last paragraph of his letter which I found so interesting. I have felt for many years that it was a great pity that students could not have the benefit of visiting lecturers from outside teaching circles. Surely it might be possible to fit a certain number of lectures by such visitors into the ordinary curriculum, together with sessions by visiting surgeons, in order that students might appreciate that there are varied and successful methods of doing any particular job. There must be, within reasonable reach of most of the schools, a number of veterinary surgeons in different spheres of activity but all actually doing that job as a daily task in the field, who could deliver a few lectures or give a few demonstrations each year related to his own particular interest; for example, veterinary investigation officers, surgeons specialising in certain techniques, general practitioners and so on, all of whom could teach so well what they are doing from day to day.

I am fully aware that students ask visitors to talk to their veterinary medical and student associations but to my mind this is not enough. I heartily agree with Mr. Pickering that there is a considerable source of teaching talent as yet untapped.

May we perhaps hear from those better qualified to discuss the curricula than ourselves whether some such scheme would be feasible? If it were, it should do much to counter the criticism of those members in practice who constantly complain that students are taught in a too rarefied atmosphere and cannot adapt their teaching to the hurly-burly of everyday veterinary life after they leave the schools.

Yours faithfully,

JOAN O. JOSHUA.

78, Brentway,
Finchley, N.3.

October 26th, 1960.

Infectious (Epidemic) Equine Coughing

Sir,—I have been asked to furnish readers of THE VETERINARY RECORD with some notes on the outbreak of coughing which is widespread in Britain at present.

A certain amount of coughing is encountered nearly every year, perhaps especially when the weather is dry and dusty, and sometimes it is difficult to know whether the coughing is the result of inhaling irritant dust particles, to which many horses are exposed in a dry, windy summer, or whether it is infectious. However, in 1954 and again this year, the widespread nature of the coughing, the similarity in the symptoms shown, and the course it runs in individual horses and in stables, leave little doubt that it is truly infectious.

The typical history is that a hitherto healthy, normal horse commences to cough quite suddenly, perhaps a day or two after returning from a race-meeting, a show or a pony rally, etc. In from 24 to 60 hours more horses in the same premises commence to cough and 24 or 48 hours later still 90 to 95 per cent. of all the horses, irrespective of age or condition, are affected.

The symptoms are those of a deep-seated somewhat harsh, dry cough, which may occur in spasms of 5 or 6 to 10 or more coughs following each other at short intervals. Between spasms the horse appears fairly normal or only slightly depressed. There may be a temporary initial rise in temperature to 102° or 103° F., sometimes before a cough is heard, or the temperature may not rise until the third or fourth day, when it may reach 104° F. or a little more. In either case the fever seldom lasts more than 48 hours or so. However, in the present (1960) outbreak raised temperatures have not been common, which is in contrast to that in 1954.

Coughing lasts for from 3 or 4 days in mild cases, and up to about 10 or 12 in those that are more prolonged; the severity of the actual spasms of coughing are not correlated with the duration of the illness.

In the present outbreak complications are the exception rather than the rule, but in a few horses sequelae such as nasal catarrh, excessive lachrymation, mild bronchitis, or even signs of mild broncho-pneumonia have been seen, and these are always possible in any horse.

In the majority of cases, the horse gradually stops coughing and returns to normal, and in 3 or 4 days from the last cough, can be regarded as recovered.

In a small proportion of cases a second attack has occurred in a recovered horse in from 3 to 5 weeks. This indicates that no strong immunity is conferred from a natural attack in these cases. In the majority of horses, however, recovery is complete and in them presumably some amount of protection follows.

From a study of all the circumstances of the coughing outbreaks experienced, it is impossible to escape the conclusion that the pathological condition is due to the invasion of the mucosa of the bronchioles by an infective virus. However, efforts to isolate a specific virus have so far been unsuccessful, possibly because the virus is strongly cellulotropic.

The coughing epidemic is particularly difficult to investigate since death from uncomplicated coughing is extremely rare, if indeed it occurs at all. However, the essential lesion is a bronchiolitis, affecting the mucosa of the smallest ramifications of the bronchial tree. These contain small amounts of a custard-like catarrhal exudate in which there are numbers of lymphocytes. The larger bronchial tubes are normal, and there is neither bronchitis nor any of the râles or bronchial sounds, audible by stethoscope, which are normally associated with typical bronchitis.

There has never been any inflammation, swelling, pain on palpation, or other signs of laryngitis found present in uncomplicated cases of coughing and consequently there is no point in exhibiting electuaries, throat liniments, and so on, during treatment. The cough is, in fact, a reflex cough from irritation and obstruction in the smallest of the bronchioles, and has the object of improving pulmonary ventilation and thereby preventing aleveolar collapse.

It will be obvious from the above that treatment is most logically directed towards providing the best hygienic conditions possible, warmth, fresh air, light, easily digested food, mashes, green foods if available, plenty of water constantly present, and allow exercise for short periods, always provided the temperature is normal.

In cases where secondary infections (often streptococci) occur, appropriate antibiotic treatment together with inhalations of medicated steam are useful. Return to work should be gradual, and for about a week or 10 days after recovery undue respiratory stress or distress should be avoided.

The condition of coughing is so extremely infectious that efforts at isolation or quarantine are futile. It can be safely assumed that when the first spasm of coughing is heard in a stable it is already too late to hope to limit the spread of infection to other horses on the premises since many of them will already be in the incubative stages and can be expected to show coughing during the next 24 to 48 hours.

It is perhaps desirable to point out that the infectious cough is not essentially a serious disease or health problem in the form which it has taken up to date. It is impossible to predict whether in future the infectiousness, the virulence, or the clinical severity of the condition, may change or not. There may be waxing or waning of any of these characteristics, in which case the above conclusion may require to be reviewed. In the meantime, however, while the nuisance effects—loss of show, sale or racing engagements, and consequent monetary loss to some owners, etc.—should be fully appreciated, they need not be exaggerated. Perhaps the most marked effect has been the drastic reduction in the numbers of horses which have been able to fulfil their racing engagements between July and the present. In many races as many as 50 per cent. of the horses entered and expected to run have had to be withdrawn, often at only a few hours' notice, because they succumbed to coughing.

At the time of writing the more northern racing stables are largely clear, and in more southern districts the outbreak has reached and probably passed its peak.

In conclusion, it may be noted that although there has been ample opportunity for coughing to spread from the racing stables by personnel, movement of horses at the times of the various Summer and Autumn Sales, horse-boxes, and in other ways, to the breeding studs, such spread has not occurred. Indeed so far as can be ascertained the studs have been almost entirely free from infection.

Yours faithfully,

Wm. C. MILLER.

Animal Health Trust,
Equine Research Station,
Balaton Lodge,
Newmarket,
Suffolk.

October 21st, 1960.

Infestation of a Monkey with the Leech *Dinobdella ferox*

Sir,—We wish to record the infestation of a rhesus monkey, *Macaca mulatta*, with the leech *Dinobdella ferox*. Although one of us has observed well over 20 thousand rhesus monkeys and several thousand cynomolgus monkeys (*Macaca irus philippinensis*) for periods of from 2 weeks to 6 months, this is the only occasion when a leech has been seen. The monkey concerned was a male weighing approximately 3 kg. which had been purchased from a dealer in Delhi, India, and imported into this country on April 14th, 1960. It was caged with one companion until June 10th and then isolated in a test quarantine cage.

On June 13th it was noticed that the monkey had blood coming from its left nostril. On closer examination a dark red mass was seen deep inside the nostril. This was grasped with a pair of artery forceps and when gentle traction was applied it elongated to about three inches before releasing its hold.

D. ferox is widely distributed in India, Burma and Ceylon (Harding & Moore, 1927). The jaws are weak and have no teeth, so that the leech is unable to pierce the outer body covering of its host. Instead it enters the nasal cavities of mammals and sucks blood from the mucous membrane. The yak, buffalo, domestic cow, horse, dog and deer are known to suffer from its attacks, but we know of no previous record of its association with monkeys. It normally enters the nostril when the animal is drinking and appears to stay with the host for long periods, possibly for life. The first description of the leech (Murie, 1863) was of a specimen recovered from a deer, *Cervus moluccensis*, which died in the London Zoological Gardens, having spent some time in Amsterdam on the way from its native Moluccas, and there are other records of specimens having been recovered from yaks and buffaloes imported into the zoological gardens of Europe. In the case of the specimen obtained from the monkey, it is clear that it had been with its host for upwards of three months.

Yours faithfully,

J. E. C. BYWATER.

Pfizer Ltd.,
Richborough, Nr. Sandwich,
Kent.

K. H. MANN.

Department of Zoology,
The University,
Reading, Berks.

October 21st, 1960.

References

HARDING, W. A., & MOORE, J. P. (1927). "The Fauna of British India." Hirudinea, London.

MURIE, J. (1865). *Proc. zool. Soc. Lond.* 659.

The Racing Greyhound

Sir,—J. K. Bateman is to be congratulated on his excellent article in last week's issue of THE RECORD.

I note that he states (page 894) "It has been possible, too, because of the large number of dogs involved, to gauge the economic importance of 'fashionable' diseases, *e.g.* C.V.H. . . ." Many of us would be interested if you could persuade Bateman to enlarge on this statement giving us his views on the relative importance of the disease. We would also like to know if he vaccinates the Greyhounds in his kennels and if so, what type of vaccine he uses and his reasons for this choice.

Yours faithfully,
J. W. H. HOLMES.

81a, Wantage Road,
Wallingford,
Berks.

October 25th, 1960.

Artificial Insemination in the Chinchilla

Sir,—May I make known through your columns that I urgently require information on the subject of artificial insemination in the chinchilla from those of your readers who have practical experience in this field.

Yours faithfully,
JOHN G. WATSON.

Craig Royston,
Nairn.

October 21st, 1960.

Discovery by the Animal Health Trust

Sir,—My attention has been drawn to reports in the daily press on Tuesday, October 18th, of a speech I made on the previous day concerning the work of the Animal Health Trust. In this speech I referred to some incomplete work of Dr. Archer at the Equine Research Station of the Trust upon eosinophil leucocytes. My remarks were misinterpreted to read that a therapeutic preparation is available from these leucocytes, which was not what I said.

For the information of those who may be interested, the work, in so far as it has progressed, is published in the *British Journal of Haemotology*, Volume 6, page 229, July, 1960.

A great deal of development will be required before the substance can be used in clinical tests and a firm opinion arrived at concerning its therapeutic potentialities.

Yours faithfully,
W. R. WOOLDRIDGE.

The Animal Health Trust,
14 Ashley Place,
Westminster,
London, S.W.1.

October 21st, 1960.

"Disease" of Turkey Poults

Sir,—My attention has been called to a letter which appeared in the August 27th issue of THE VETERINARY RECORD. The author of this letter suggested that the recent "mystery" disease of turkey poults might be attributed to a toxic carbohydrate found in American milo maize. We are somewhat puzzled and amused by his comments since we have fed several thousand tons of this material in the poultry area where I live. We have at no time seen evidence of such symptoms. I should be interested to learn the carbohydrate to which he attributes this toxicity since I am not aware of such a material in grain sorghums.

It would also appear from his references that the author of the letter is confusing grain sorghum forage with grain from grain sorghum. The two are quite different relative to their toxic principles following a drought or similar condition which would cause the forage to change its growth pattern.

Yours faithfully,
E. L. STEPHENSON.

Division of Agriculture,
University of Arkansas.

October 13th, 1960.

Veterinary Education

Sir,—I have read Mr. Pickering's letter in to-day's VETERINARY RECORD. I do not know him personally but judging from those of his contributions to veterinary literature that I have read, I would agree that he is fully entitled to the satisfaction that he has expressed with himself as clinician. On the other hand, I think he has rather "done it" this time in the confidence of his confessed ignorance.

I write as a clinical teacher who previously spent several years in his own practice, and I admit that I find teaching the more difficult occupation (rather less lucrative too).

I think it likely that most teachers sometimes ask themselves whether they are "good" or "bad" but where are they to get their answer? From Mr. Pickering? I warn him against listening too seriously to the students he meets. If he could hear how mine misquote me in their examinations he would either see my point or class me as "bad." I believe that all one would get from students would be a kind of popularity poll, and it has yet to be proved that a popular teacher is necessarily efficient.

Perhaps, Mr. Editor, your journal would award an annual Oscar for veterinary teachers? That might encourage us to resign rather than wait to be "got rid of." Can this be a euphemism for that other euphemism "liquidated"?

Yours faithfully,
F. R. SPRATLING.

Department of Veterinary Clinical Studies,
School of Veterinary Medicine,
Madingley Road,
Cambridge.

October 22nd, 1960